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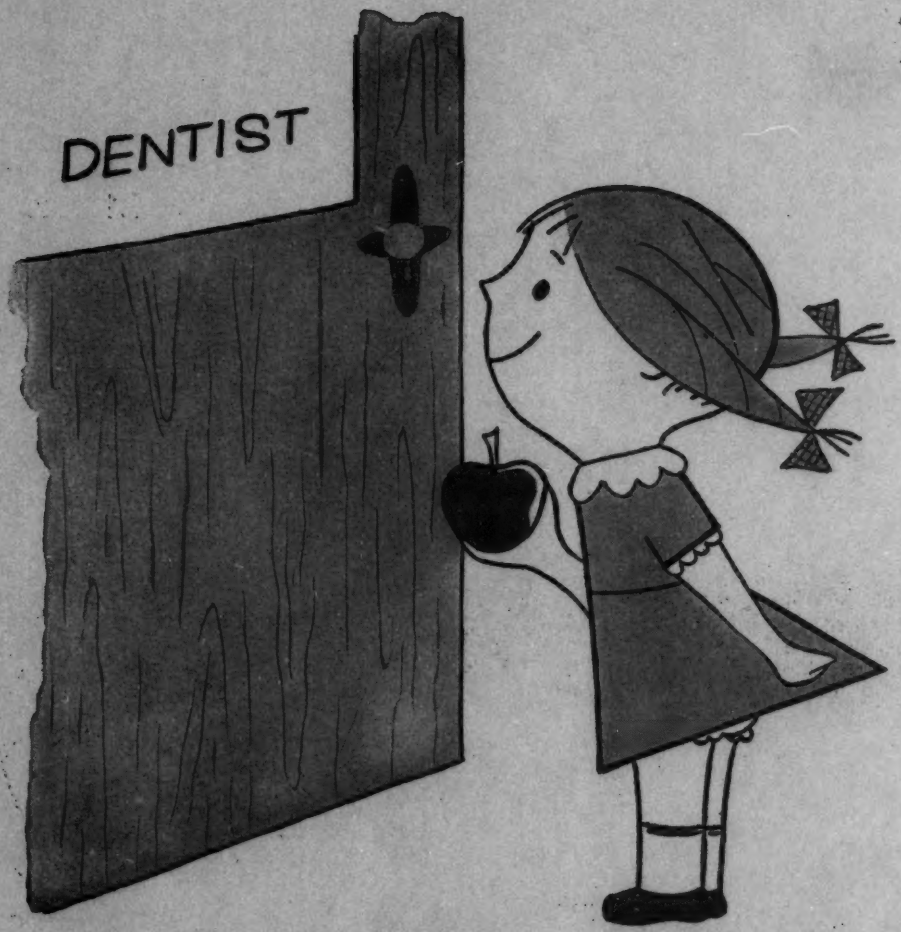

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Fred A. Henny, D.D.S., Editor
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VOLUME 14 • JANUARY 1956 • NUMBER 1 JOURNAL OF ORAL SURGERY

Osseous dysplasia: reaction of bone to injury

■ *Hamilton B. G. Robinson, D.D.S., M.S., Columbus, Ohio*

The jaw bones frequently are sites of bone lesions characterized by radiolucency or radiopacity. The bones may or may not be enlarged by the processes producing these changes in radiodensity. Histologically, the character of these lesions varies from accumulations of giant cells to dense sclerotic bone. Some of these changes are caused by general bone diseases such as osteitis fibrosa cystica, Albright's syndrome, Paget's disease and fibrous dysplasia, or by benign or malignant neoplasms. Still others are less specific and probably represent reactions to injury.

Bone is the most plastic of body tissues. During bone growth, osteoblastic activity predominates over osteoclastic activity. When bone is being resorbed, osteoblastic action is more prominent, whether the resorption is the result of pressure, disuse, inflammation, or metabolic or neoplastic activity. During the maintenance period, osteoclastic and osteoblastic activity are minimal and equal. In dysplasia the relationship of osteoclastic action and osteoblastic action is disturbed. These conditions may be indicated diagrammatically:

Osteoblastic activity > osteoclastic activity = growth, sclerosis, osteogenic tumors and hyperostoses.

Osteoclastic activity > osteoblastic activity = atrophy, giant cell lesions, osteitis fibrosa cystica and osteolytic tumors.

Osteoblastic activity = osteoclastic activity = maintenance.

Osteoblastic activity and osteoclastic activity are disorganized = dysplasia (fibrous, osseous) and Paget's disease.

The maxilla and mandible are unique bones in that they contain numerous teeth embedded in the bone and projecting outside the body tissues into the oral cavity. In no other bones is there a comparable situation. The teeth and their supporting structures are subject to disease of bacterial, chemical and traumatic origin. This peculiarity multiplies the opportunity for injury in the jaw bones far beyond that in other bones. For this reason

Presented at the annual meeting of the American Society of Oral Surgeons, Hollywood Beach, Fla., November 6, 1954.

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more changes should be anticipated in the bones of the jaws than in any other bone. The frequent observation of these lesions has led to a contempt for them, on one hand, and a complication of classification, on the other.

True fibrous dysplasia of the bone has been described adequately by Lichtenstein,[1,2] Jaffe[3] and Albright.[4] The full-blown form of fibrous dysplasia and Albright's syndrome are relatively rare, but the limited type of fibrous dysplasia without pigmentation is 20 or 30 times more frequent.[3] A developmental error has been suggested as the cause of fibrous dysplasia, classifying it as a hamartoma.[5] The clinical and pathologic appearance has been reviewed by Jaffe.[6] Schlumberger[7] described the appearance of fibrous dysplasia in the jaw bones.

Localized regions of bone expansion have been classified by Thoma[8] as fibro-osteomas or ossifying fibromas. Discussions of fibrous dysplasia (a developmental disturbance) versus ossifying fibroma (a neoplasm) often have been presented. Unquestionably, fibrous neoplasms occur

1. Lichtenstein, L., and Jaffe, H. L. Fibrous dysplasia of bone. Arch. Path. 33:777 June 1942.

2. Lichtenstein, L. Polyostotic fibrous dysplasia. Arch. Surg. 36:874 May 1938.

3. Jaffe, H. L. Fibrous dysplasia of bone. Bull. New York Acad. Med. 22:588 Nov. 1946.

4. Albright, F. Syndrome characterized by osteitis fibrosa disseminata, areas of pigmentation and endocrine dysfunction, with precocious puberty in females; report of 5 cases. New England J. Med. 216:727 April 29, 1937.

5. Berger, A., and Jaffe, H. L. Fibrous (fibro-osseous) dysplasia of jaw bones. J. Oral Surg. 11:3 Jan. 1953.

6. Jaffe, H. L. Paper presented at the thirty-sixth annual meeting of the American Society of Oral Surgeons, Hollywood, Fla., November 6, 1954.

7. Schlumberger, H. G. Fibrous dysplasia (ossifying fibroma) of the maxilla and mandible. Am. J. Orthodont. & Oral Surg. (Oral Surg. Sect.) 32:579 Sept. 1946.

8. Thoma, K. H. Paper presented at the thirty-sixth annual meeting of the American Society of Oral Surgeons, Hollywood, Fla., November 6, 1954.

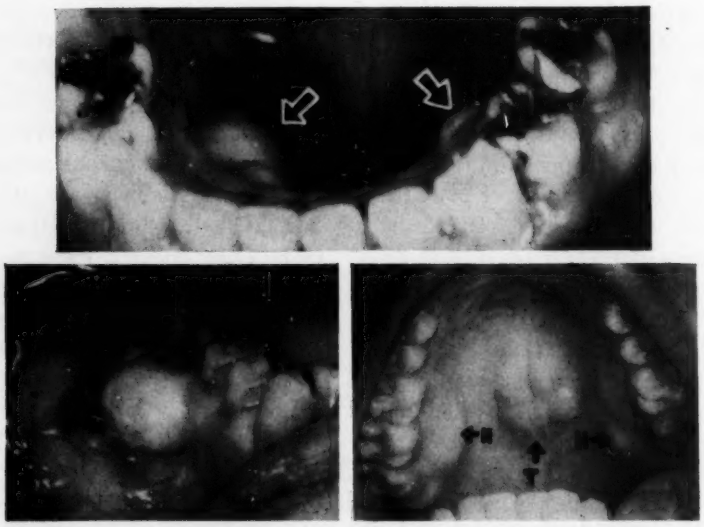

Fig. 1—Above: Torus mandibularis, usually considered an anomaly. Below left: Osteoma of mandible. Below right: Torus palatinus (T) and hyperostoses (H) in same patient

in the jaws. These tumors result in the resorption of bone and produce radiolucent regions. Histologically, bone and bone marrow are replaced by fibrous connective tissue. Since this tissue has its ancestry in cells with a potentiality for bone formation, it commonly forms osteoid, or bone, within its substance. As a result, any pattern varying from a predominance of young fibroblasts to a pattern dominated by mature bone can be predicted in a fibro-osteoma or an ossifying fibroma. Johnson[9] has pointed out that bone tumors:

> . . . share in a common biochemistry and cytology of matrix formation, and they conform to regional variations in the structure of normal bones and of the skeleton. And when tumors are analyzed with respect to space, time, and quantity—when, where and how often they occur—it would appear that they behave in an orderly and predictable manner.

The greatest problem is not in identifying true fibrous dysplasia or fibro-osseous tumors but in differentiating the reactions to injury which I propose to classify as osseous dysplasias. These lesions are relatively common in the mandible and maxilla. The tendency to identify one lesion as a neoplasm and another as a "normal variant" is illustrated by torus palatinus and torus mandibularis as compared with osteomas and hyperostoses. Torus mandibularis (Fig. 1, above) is found in approximately 8 per cent of a mixed population.[10] It is considered a frequent form of hyperostosis or exostosis. Similar enlargements of bone on the buccal or lingual surfaces of the mandible are less commonly encountered and are not as constant in position. When they occur, they usually are classified as osteomas and

Fig. 2—Hyperostosis of alveolar ridge associated with region of alveolar fracture

are considered to be neoplasms (Fig. 1, below left). They are histologically similar to a torus. Torus palatinus, found in 21 per cent of a mixed population,[10] is accepted as a simple hyperostosis possibly related to continued growth at the junction of the palatal processes, whereas those hyperostoses at other sites on the palate or alveolar process are viewed as more serious (Fig. 1, below right). In actuality these bony enlargements vary only in site and in frequency of occurrence. The same problem of differentiation between local metabolic reactions, general bone dysplasias, neoplasms and reactions to local conditions is apparent in the deeply situated fibro-osseous lesions of the jaws.

Even more pertinent are the localized regions of hyperostosis that usually represent imperfect repair of fractured alveolar processes (Fig. 2). These regions repair

9. Johnson, L. C. General theory of bone tumors. Bull. New York Acad. Med. 29:164 Feb. 1953.

10. Kolas, S., and others. Occurrence of torus palatinus and torus mandibularis in 2,478 patients. Oral Surg., Oral Med. & Oral Path. 6:1134 Sept. 1953.

as do other fractured bones, with hemorrhage, organization, osteoclastic resorption, callus formation and reconstruction. Sections of tissue from such a region will show a variation in features of "bone dysplasia" depending on the stage of repair.

Another example of reaction to injury in an isolated osseous tissue is observed with the dental pulp and dentin. The pulp forms a tissue which is physically, crystallographically and chemically similar to bone. The pulp continues to lay this dentin down long after tooth eruption, but injury may cause pulp metaplasia and may lead to dentin resorption. This internal or idiopathic resorption of dentin frequently is reversed, and osseous tissue then may repair the regions of internal resorption. This is a localized dysplasia of calcified tissues.

■ *Osseous Dysplasia*

The reaction of the bone of the jaws to injury is observed most often with the dental granuloma. Here bacteria or their toxins have reached the periodontal membrane which is the periosteum of the alveolar bone. Periostitis, osteitis and focal osteomyelitis then result in bone resorp-

Fig. 3—Left: Periapical radiolucency on tooth with vital pulp. Right: Periapical radiopacity on tooth with vital pulp

Fig. 4—Left: Giant cell lesion seen as a radiolucency over an unerupted second bicuspid. Right: Bone expansion associated with osseous dysplasia and giant cell lesion seen in Figure 4, left

tion and replacement by connective tissue. The result is seen as a radiolucent area in the roentgenogram. Less frequently a radiolucency is observed at the periapical region of teeth without pulpal involvement (Fig. 3, left). This lesion has been called first stage cementoma, benign periapical fibroma and traumatic osteoclasia. Either spontaneously or after the tooth is removed from occlusal contact, the periapical region will become radiopaque (Fig. 3, right). These dense lesions, which usually are surrounded by radiolucency, have been termed cementomas, but cementum is "a specialized, calcified tissue of mesodermal origin, a modified type of bone covering the anatomic roots of the teeth."[11] Since the lesions in question are not attached to the roots but often remain after the removal of teeth, they are not composed of cementum. They are not neoplasms but are reactions to periapical injury, possibly from occlusal trauma, and as such represent two stages of osseous dysplasia, one fibrous and one calcified. They may be classified as periapical osseous dysplasias.

When a region of bone is injured, some resorption usually ensues. The amount of resorption may be relatively insignificant or may be extensive. All the factors governing the degree of resorption are not known, but the extent and the severity of the injury and general or local chemical reactions are paramount. The regions of resorption are often called giant cell tumors, although the term "tumors"

11. Orban, B. Oral histology and embryology, ed. 3. St. Louis, C. V. Mosby Co., 1953, p. 154.

Fig. 5—Osseous dysplasia associated with region of periapical infection. Dense region of sclerotic bone (cementoma?) is seen at arrow. Note local bone expansion

is gaining disrepute when applied to a reaction of this type. The more acceptable terms are reparative giant cell lesion, or, simply, giant cell lesion. A true giant cell tumor of bone, however, exists.[12]

The shadow of a giant cell lesion is seen over the unerupted mandibular second bicuspid of a young girl in Figure 4, left. Histologically, this was predominantly a giant cell lesion (osteolytic), although some osteoblastic activity was observed. Roentgenographically, calcification is apparent in the upper radiolucent region, the region of bone reaction. The expansion of the bone, observable in Figure 4, right, is evidence of reconstruction. This lesion is a form of osseous dysplasia associated with injury about the follicle of the unerupted bicuspid. It is commonly and correctly called a giant cell lesion.

As indicated in the region of periapical osseous dysplasia, calcification may follow resorption, and usually does, if the body defenses overcome the irritating agents, or if the dentist eliminates them. At times the tide of battle between the irritation and the tissues flows back and forth leaving regions of resorption interspersed with regions of calcification. These are representative of the confusing lesions which are neither neoplasms (fibro-osteomas, ossifying fibromas) nor hamartomas (fibrous dysplasias). They are localized in one or more regions within the maxilla or mandible. Usually they are in one region, but just as one may have multiple dental granulomas or multiple periapical osseous dysplasias (cementomas), one may also have multiple regions with osseous reaction to injury. The lesions may result in bone expansion (Fig. 5) or may remain in the central portion of the bone without effect on the cortical plates.

Roentgenographically, the appearance seems mottled with radiopaque masses seen in a radiolucent region. The dense mass centrally is a root tip. It is probable that this is the center of the irritation. In all likelihood infection about this root tip initiated the osseous dysplasia, and the flow of the battle between invasion and tissue resistance produced the bone pattern.

Histologically, resorption, fibrous tissue, trabeculated bone and dense bone may be observed in the region (Fig. 6). These different illustrations represent various phases in the osseous reaction to injury and the repair process. The final pattern produced if the injury is overcome may be sclerotic bone without expansion of the cortical plates or with considerable

12. Bernier, J. L., and Cahn, L. R. Peripheral giant cell reparative granuloma. J.A.D.A. 49:141 Aug. 1954.

increase in the size of the bone. Figure 7 shows a greatly expanded mandible in a patient with a prolonged osseous dysplasia after infection of the mandible.

Osseous dysplasia may be defined as the altered reaction of bone to injury. Its pattern may vary from the radiolucent type with predominating osteoclastic activity to the radiopaque (sclerotic) type with osteoblastic activity leading to densely calcified bone. An intermediate type may show mottling in a roentgenogram, with osteoclastic and osteoblastic activity. The lesions usually are localized to a single region of bone but may be multiple. The presence of a retained tooth root or a tooth with periapical inflammation, or a history of extraction of an infected tooth offers clues to the injury. Whether the cortical layer of bone is ex-

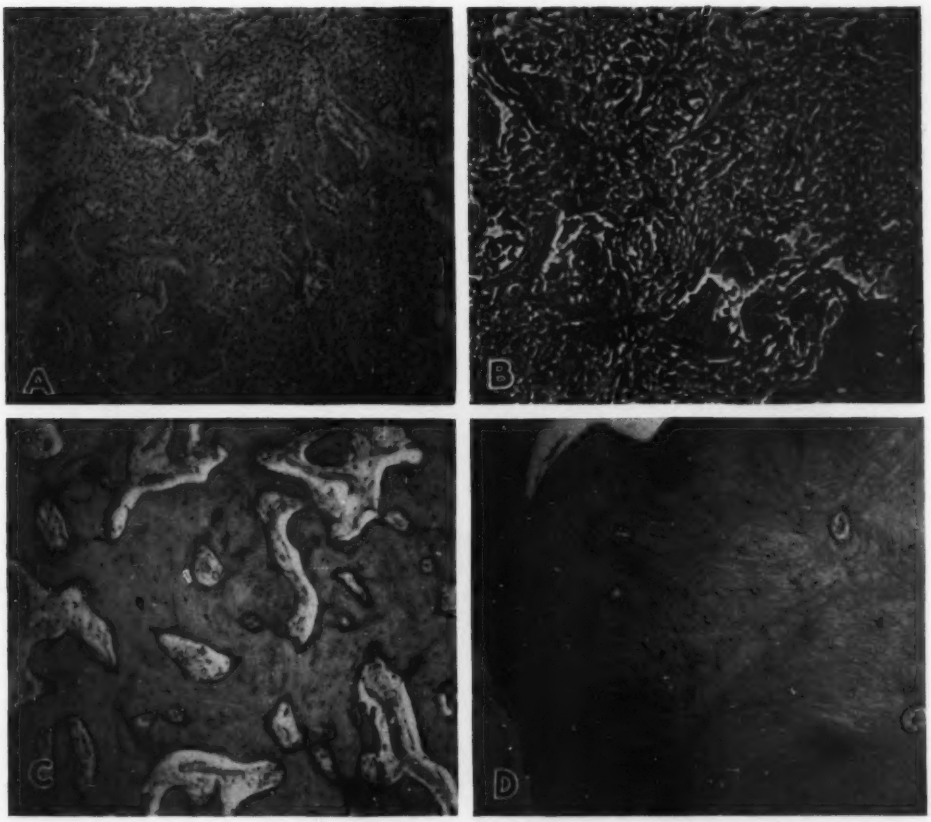

Fig. 6—Various patterns of bone and osteogenic tissue in osseous dysplasia. These are from lesion in Figure 5. A: Osteoclasia predominating (osteoclasts indicated by arrows). B: Dense fibrous marrow. C: Trabeculated bone of type seen in osteomas. D: Dense sclerotic bone

panded depends on the quantity and quality of the reaction. When the bone is enlarged, the expansion is usually fairly well localized. Osseous dysplasia may occur at any age, but it is rare before pulpal invasion of permanent teeth with subsequent periapical infection. The traumatogenic type (periapical osseous dysplasia) is observed in young adults.

■ *Differentiation*

Fibrous dysplasia of the relatively rare florid type involves more than one bone and is associated with pigmentation of the skin. The monostotic type of fibrous dysplasia is not common in the jaws, and when it does appear it usually is at or before adolescence. The enlargement is more or less generalized over the mandible or maxilla and slowly results in facial asymmetry. The roentgenogram gives a picture of increased density of bone (radiopacity). In the mandible the roentgenogram usually shows an opacity suggesting ground glass. Albright's syndrome is characterized by multiple bone lesions, pigmentation of the skin, precocious sexual development and endocrine abnormalities. This rare syndrome is differentiated by the bone reaction and the added clinical manifestations.

Ossifying fibromas and fibro-osteomas are neoplasms. The lesions are found predominantly in young people. Thoma differentiates these two neoplasms: In ossifying fibromas, fibroblasts predominate with osteoid and bone trabeculae as secondary elements. The fibro-osteoma has considerable intercellular material deposited irregularly or in broad trabeculae. The fibro-osteomas often are overlooked until expansion of the maxilla or mandible has resulted in occlusal disharmonies or facial

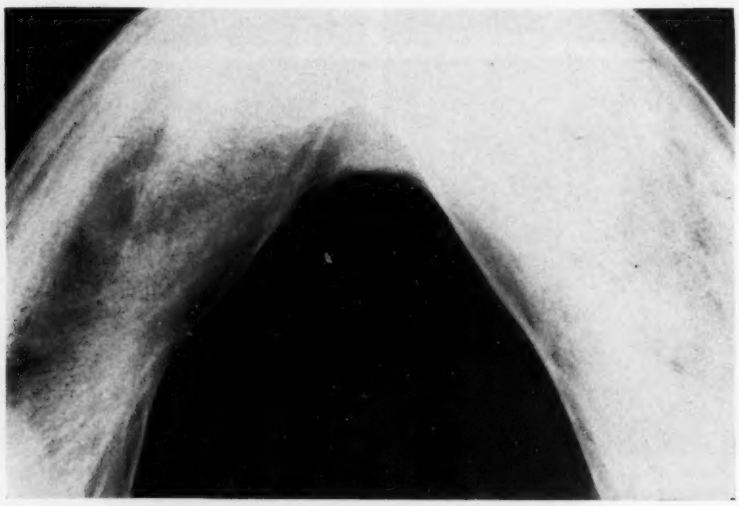

Fig. 7—Expanded bone associated with long-standing osseous dysplasia of mandible

swelling, unless they are observed roentgenographically by the careful observer in routine examination. The tumor usually is circumscribed, painless and nontender. The roentgenographic appearance in the maxilla is that of increased density, often with obliteration of the sinus. In the mandible there may be a cystlike radiolucency or a slightly radiopaque expanded mass.

Osteitis fibrosa cystica (Fig. 8) shows multiple bone lesions, increased serum calcium, decreased serum phosphorus and increased serum alkaline phosphatase. It is due to parathyroid adenoma.

Paget's disease (osteitis deformans) usually begins after middle age and affects many bones. The maxilla may be enlarged (Fig. 9, left) and the skull thickened (Fig. 9, right). The roentgenograms show the so-called cotton-wool pattern resembling absorbent cotton (Fig. 10).

Erythroblastic anemias (thalassemia, sickle cell anemia) may result in changes in the skull and facial bones (Fig. 11, above left and right) and in the alveolar bone pattern (Fig. 11, below). These changes are characteristic.

The xanthomas, trauma (extravasation lesions or "cysts") and other neoplasms may produce bone lesions which must be differentiated from fibro-osseous lesions. The history, clinical and roentgenographic appearance and biopsy report are needed to identify them. When a biopsy of an intraosseous lesion is made, tissue from regions other than the edge of the defect must be included. At the bony border, the reaction to expansion and possibly to regression of the lesion may give an appearance suggesting fibrous dysplasia or osseous dysplasia.

Fig. 8—Mandible of patient with osteitis fibrosa cystica. This lesion was characterized by giant cells in a connective tissue stroma

■ *Summary*

Bone is not static, but variations in balance between osteoblastic and osteoclastic activity result in production, resorption or maintenance of bone. The jaw bones are subject to reaction to injury more than are other bones because they are the only tooth-bearing bones. This unique situation may lead to bone changes from trauma or infection in and about the teeth as well as from the traumatic, metabolic, neoplastic and infectious processes that affect other bones.

Osseous dysplasia has been described as an altered reaction of bone to injury.

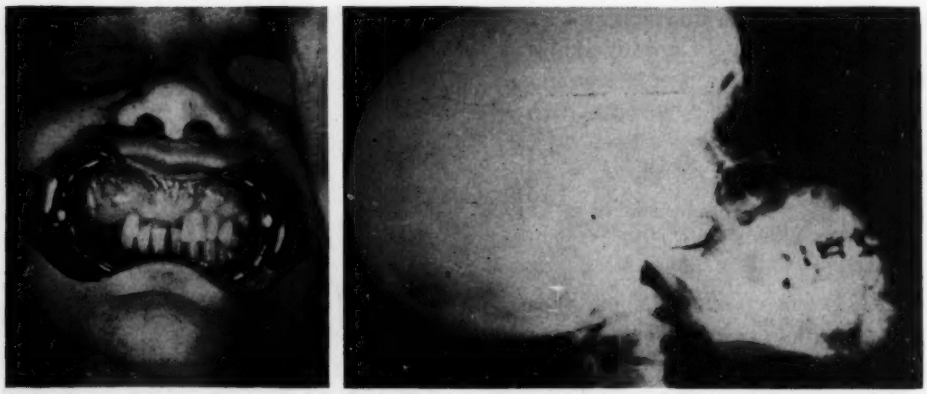

Fig. 9—Left: Patient with osteitis deformans showing maxillary enlargement. Right: Skull of same patient with osteitis deformans

Its roentgenographic appearance varies from one of radiolucency through mottling to dense regions of radiopacity. The lesions usually are localized in a simple region of dental or apical periodontal infection or a region of an extracted tooth, although the possibility of multiple regions of reaction cannot be overlooked

Fig. 10—Left: Occlusal roentgenogram of maxilla seen in Figure 9. Note absorbent cotton ("cotton-wool") pattern. Right: Dense area of "cotton-wool" bone pattern in patient with osteitis deformans of maxilla

any more than multiplicity of dental granulomas. The cortical layer of bone may or may not be expanded. Histologically, the pattern varies from one predominated by osteoclastic activity to one characterized by osteoblastic activity with production of trabeculated or sclerotic bone. Evidence of osteoclastic action followed by osteoblastic productivity may be observed. Several different patterns may be seen in the same lesion. The age of occurrence varies, but usually the lesion is not found until after carious invasion of the pulp followed by periapical damage.

Fig. 11—Above left: Facial distortion in patient with erythroblastic anemia. Above right: Roentgenograms of skull of patient seen in view above left. Note trabeculae radically arranged at border of cranium. Below left: Roentgenogram of alveolar process and teeth of same patient. Note fine trabecular pattern

Periapical osseous dysplasia occurs as a radiolucent or radiopaque region about the apex of a tooth without pulp disease. These lesions have been described as first stage cementomas (radiolucent), benign periapical fibromas or traumatic osteoclasias and as cementomas (radiopaque).

Fibrous dysplasias, fibro-osteomas (ossifying fibromas), other neoplasms, and general metabolic bone diseases and general infectious bone diseases must be differentiated from osseous dysplasias.

Balloon technic for treatment of fractures of the zygomatic bone

■ *Vernard R. Jackson,* D.D.S.; Joseph A. Abbey,† M.D., and Sanford Glanz,‡ M.D., Corpus Christi, Texas*

The zygomatic bone is the most commonly fractured facial bone after the mandible and the nasal bones.[1] Displaced zygomatic bones easily may be overlooked after an accident because of excessive swelling and ecchymosis of the overlying tissues. A depressed fracture of this kind, when not corrected, frequently results in a conspicuous deformity. If the adjacent infraorbital rim of the maxilla is depressed or comminuted, the normal position of the eye is changed, and permanent diplopia often results.

In the diagnosing of fractures of the facial bones of the zygomatic or orbital regions, a detailed history is considered essential. This history should include the time of injury and the type of object traumatizing the orbit. A thorough study of roentgenograms in the posteroanterior and the Waters' positions which display both orbits and the maxilla should be made. Because of edema, the initial inspection and palpation of the orbital region may be misleading.

An important factor to be remembered in the reduction of zygomatic fractures is the time element. The earliest permissible time after the accident is considered ideal, since there has been no opportunity for fibrous union, and reduc-

The opinions and assertions contained in this article are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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1. Gerrie, John. Face injury in sport. Plast. & Reconstruct. Surg. 14:224 Sept. 1954.

tion usually can be accomplished without added difficulties.

It is extremely important that the traumatized eye be examined by an ophthalmologist for any evidence of lid and optic nerve damage. Infringement on the infraorbital nerve with loss of cutaneous sensation might be noted. Reduction of the fractures usually corrects extraocular disturbances of this kind.

There are three commonly used methods[2] of reducing zygomatic fractures:

1. In the extraoral approach, reduction is accomplished by means of a screw or hook inserted through a small incision on the cheek so that the bone is engaged or lifted by the instrument.

2. In an intraoral approach,[3] the maxillary sinus is entered above the molar teeth or canine fossa, as in the classic Caldwell-Luc operation, and applied leverage is exerted in such a manner that the depressed fragments are properly elevated and aligned. In this method the sinus must be firmly packed with petroleum jelly or iodoform gauze to hold the fragments in place.

3. The Gillies method, whereby an instrument is passed downward and forward beneath the temporal fascia until the instrument tip lies opposite the depressed fracture,[4] can be used. Leverage is then applied to reduce the fracture.

An additional method that has been used successfully at the U. S. Naval Hospital at Corpus Christi, Texas, is the Shea-Anthony Antral Balloon technic.[5] This technic is advocated for fractures involving the infraorbital ridge and the anterior surface of the maxilla. Endotracheal anesthesia is preferred in this operation because of profuse bleeding from the wide intranasal opening obtained by an antrostomy, which is necessary in the initial phase of the operation. A completely deflated antral balloon (Fig. 1, above) is inserted. After the balloon is seated in the maxillary sinus it is filled with air from a Luer-Lok syringe, using a 21 gauge needle (Fig. 1, right). Approximately 10 to 15 cc. of air will cause pressure sufficient to displace the fragments into their correct positions. The position of the bones may then be determined easily by external palpation, and correct alignment can be gauged by varying the air pressure of the balloon. Roentgenograms may be taken after the patient recovers from the anesthesia, and if further alignment should be necessary, adjustments can be made in the air pressure without too much discomfort for the patient. Since the balloon serves as an ideal fixation appliance until fibrous union has occurred, packing of the antrum is unnecessary. The balloon technic can be used in conjunction with the Gillies, hook, or external traction[6] method for depressed zygomatic bones when the anterior surface of the maxilla is severely comminuted and the balloon force does not completely align the depressed fragments of the zygomatic bone.

When the balloon has been in the maxillary sinus for a time sufficient to accomplish adequate fixation, it is removed.

2. Padgett, E. C., and Stephenson, K. L. Plastic and reconstructive surgery, ed. 1. Springfield, Ill., Charles C Thomas, Publisher, 1948, p. 235.

3. Major, Glenn. Fractures of the jaws and other facial bones. St. Louis, C. V. Mosby Co., 1943, p. 348-350.

4. Kazanjian, V. H., and Converse, J. M. Surgical treatment of facial injuries. Baltimore, Williams & Wilkins Co., 1949, p. 186-188.

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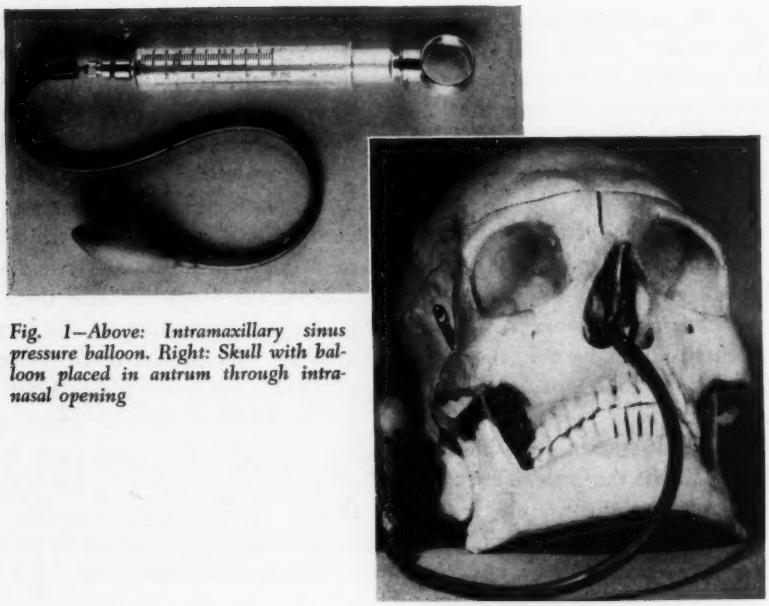

Fig. 1—Above: Intramaxillary sinus pressure balloon. Right: Skull with balloon placed in antrum through intranasal opening

After deflation, and with gentle traction on the stem, it is gradually withdrawn through the intranasal antral opening. Anesthesia is not necessary for removal of the balloon. Antibiotics are administered as indicated during the treatment period.

The following report of cases will help to clarify the use of the balloon technic.

■ *Case 1*

A 22 year old man received a blow on the right side of the face while he was engaged in a fist fight. He reported to the naval hospital complaining of pain and swelling of the right side of the face. Physical examination was essentially negative except for moderate swelling over the right side of the face, ecchymosis of the right orbital tissues and subconjunctival hemorrhage of the right eye. Multiple roentgenograms of the skull and facial bones revealed a fracture of the right zygomatic bone with a portion of the anterior border projecting inwardly into the maxillary sinus (Fig. 2, left). There were fractures through the midportion of the inferior rim of the right orbit and also through the junction of the zygomatic bone and the zygomatic arch. The nasal bones were fractured. That the right antrum was densely clouded suggested that there was blood in the antrum. Antibiotic therapy was started immediately.

Subsequently, under endotracheal thiopental sodium and nitrous oxide anesthesia, a wide intranasal opening was made in the right antrum. The balloon was inserted into the sinus (Fig. 2, right). From 10 to 15 cc. of air was pumped into

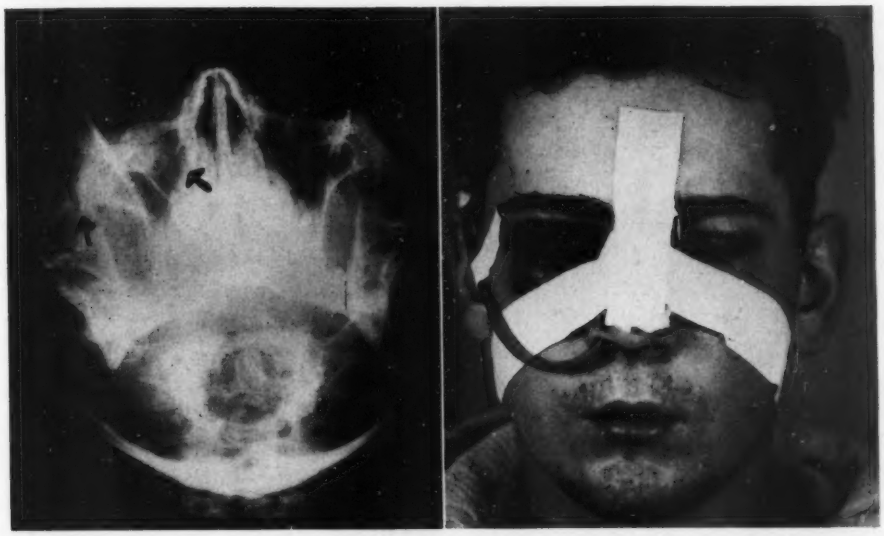

Fig. 2—Left: Compound fracture of right zygomatic bone and anterior wall of maxilla. Right: Balloon inserted in sinus. Note external metal splint for nasal bone fracture

the balloon. In this way the fractured bones of the sinus wall were elevated, and immediate alignment of the zygomatic bone resulted. This alignment was verified by roentgenograms while the patient was still under anesthesia. The balloon pressure for fixation was maintained for ten days. The patient was discharged from the hospital three days later with no complaints or optical dysfunction (Fig. 3).

■ *Case 2*

In the following case the balloon force reduced the comminuted walls of the maxillary sinus, but extra force was necessary to reduce the zygomatic fracture.

This patient similarly was involved in a fist fight and reported to the U. S.

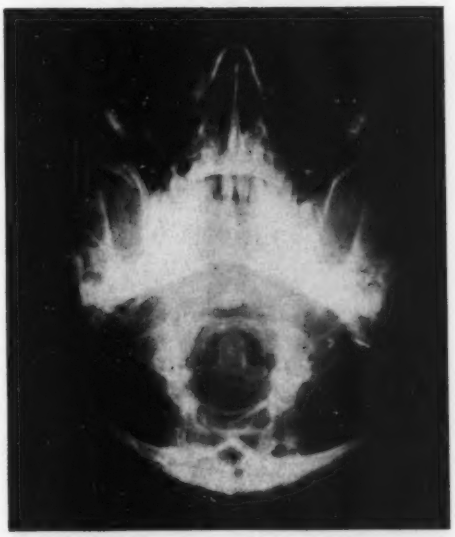

Fig. 3—View after alignment using balloon

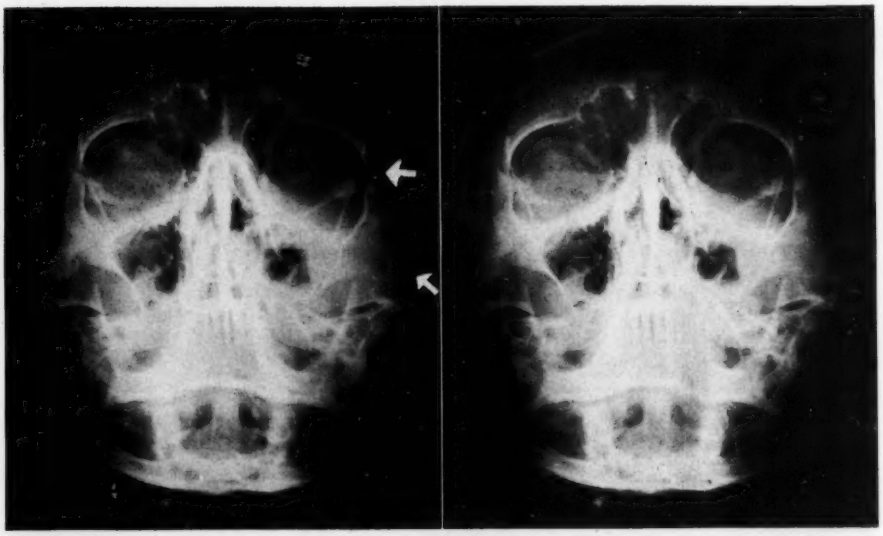

Fig. 4—Left: Compound, comminuted and depressed fracture of zygomatic bone and anterior wall of maxillary sinus. Right: Fracture reduced with balloon and external traction

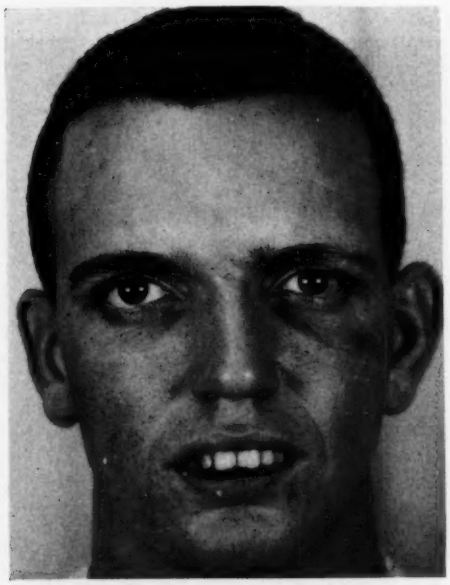

Fig. 5—Postoperative view after five days

Naval Hospital shortly thereafter complaining of soreness and swelling of the left cheek bone. Roentgenographic studies of the facial bones revealed a fracture of the lateral wall of the left orbit, another through the left zygomatic arch, and still another through the lateral wall of the left maxillary sinus. The zygomatic eminence, therefore, became a free fragment which was displaced inferiorly and medially, and thus a depression of the left cheek was produced (Fig. 4, left). Except for contusion of the orbital tissues and depression of the cheek bone, the physical examination was normal. There was no evidence of ocular dysfunction associated with the extensive damage to the infra-orbital ridge. Antibiotic therapy was started immediately.

Under thiopental sodium anesthesia

an intranasal antrostomy was performed in the left maxillary sinus for the insertion of the balloon. The balloon reduced the comminuted fragments and a portion of the infraorbital ridge of the maxilla, but because of the exophthalmos and associated emphysema of the orbital tissues together with the abrupt rise in blood pressure to 190:98, the balloon was removed and further surgery was deferred until the following day. While the patient was still under anesthesia an attempt was made to reduce the depressed portion of the zygomatic bone by the Gillies method, which proved unsatisfactory.

The following day final reduction was accomplished under local anesthesia. A bone screw was inserted into the depressed zygomatic bone and a Crawford head appliance was used with rubber bands attached to the bone screw for traction.[6] Postoperative roentgenograms revealed the fracture to be in excellent alignment. The appliance provided both traction and fixation during the remaining period of treatment. Final roentgenograms disclosed the bones to be in good alignment (Fig. 4, right), and the patient was discharged to duty without further untoward complications (Fig. 5).

■ *Summary and Conclusion*

The balloon technic when used in the reduction of depressed orbital and comminuted fractures of the zygomatic bone and anterior surface of the maxilla offers several advantages. Most comminuted or depressed zygomatic fractures are easily reduced by the equalized balloon pressure. Since the air pressure can be controlled and regulated easily, further alignment can be accomplished, if roentgenograms show it is necessary, after the patient has recovered from anesthesia. Cosmetic results are excellent since no extraoral incisions are necessary, and the intranasal opening into the antrum heals readily.

The simplicity of reduction and the excellent results obtained with the balloon technic warrant its use in selected cases.

■ OBJECT OF SCIENCE

The object of experimental science is "to discover the laws of natural phenomena, for the purpose not of foreseeing them but of regulating them at pleasure and mastering them." *Claude Bernard.*

Antibiotic treatment of the gingival sulcus in prevention of postextraction bacteremia

■ *I. B. Bender, D.D.S., and R. S. Pressman, M.D., Philadelphia*

Extraction of teeth causes trauma in the gingival sulcus and provides a pathway through which the bacteria normally inhabiting the mouth can enter the blood stream. Organisms enter the blood stream with much greater facility than had been realized previously.[1-3] About 80 to 85 per cent of all tooth extractions are followed by transient bacteremia. Cates and Christie[4] have shown that about 50 per cent of all cases of subacute bacterial endocarditis follow dental sepsis or manipulation in patients with rheumatic heart disease. An additional 14 per cent were considered to be due to some other focus of infection.

Most previous attempts to prevent postextraction bacteremia have involved the preoperative administration of chemotherapeutic agents[5] and antibiotics[6-8] by the parenteral route as a means of attacking organisms after they have entered the blood stream. The present study tests the hypothesis that bacteremia can be prevented by attacking the bacteria at their source, the gingival sulcus, before they enter the blood stream. The plan of the study is (1) to determine what effect an oral troche containing penicillin and other antibiotics has on postextraction bacteremia, (2) to determine what effect an oral troche containing antibiotics exclusive of penicillin has on postextraction bacteremia and (3) to compare the effects of the oral troches with the effect of penicillin administered intramuscularly.

■ *Procedure*

ANTIBIOTICS—Three different antibiotic preparations were compared in this study: (1) Sul Pondets, each troche made up of 20,000 units of penicillin, 50 units of bacitracin, 0.13 Gm. sulfadiazine, and 3 mg. ethyl aminobenzoate; (2) Wybiotic Troches, made up of 5 mg. neomycin, 300 units of zinc bacitracin and 2,000 units of polymyxin B sulfate and (3) 400,000 units of fortified penicillin (100,000 units of crystalline potassium penicillin and 300,000 units of procaine penicillin) for intramuscular injection.

From the research laboratories of the Albert Einstein Medical Center, Northern Division.

This study was aided by a grant from Wyeth, Inc.

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PATIENTS—Patients were taken at random from the wards and dental outpatient departments of the Albert Einstein Medical Center (Northern Division) and the Philadelphia General Hospital, the only stipulations being that each subject required extraction of two or more teeth and that he had not received antibiotics or sulfonamides during the previous ten days. Ninety-three control patients were studied concurrently[9] (at three different intervals) with 99 experimental patients. The experimental patients were divided into three groups: (1) 37 patients treated preoperatively with one Sul Pondets troche, (2) 30 patients treated preoperatively with one Wybiotic troche and (3) 32 patients treated preoperatively with one intramuscular injection of fortified penicillin.

Cases were graded on the basis of severity of trauma as follows:

Grade 1—teeth extracted with minimum trauma; considerable alveolar resorption.

Grade 2—teeth required rocking and extensive use of elevators and forceps.

Cases were also graded on the basis of gingival disease and the number of missing teeth at the time of extraction, but no correlation was found between the clinical picture and the bacterial content of the saliva.

STEPS IN PROCEDURE—Saliva samples were collected before and after administration of antibiotics. Blood samples were collected before, immediately after and ten minutes after extraction of teeth.

The methods used in collecting and storing saliva and blood have been described previously by Bender, Pressman and Tashman.[10]

The troche was administered by being permitted to dissolve slowly in the saliva. Patients were instructed to retain the troche as long as possible without swallowing. It took 20 to 30 minutes for complete solution in the mouth. Injection of penicillin was made one hour before tooth extraction, as it has been demonstrated that optimum concentration of penicillin in blood and saliva occurs at the end of the first hour.[11]

The technics of making the aerobic and anaerobic cultures, of isolating the types of organisms, and of assaying the penicillin content of blood serum and saliva have been described previously.[10]

■ *Results*

BACTERIAL POPULATION COUNTS IN SALIVA—Administration of one Sul Pondets troche lowered the average aerobic bacteria count in the mouth from 31,700,000 per milliliter of saliva to 4,300,000 per milliliter of saliva. One Wybiotic troche lowered the average aerobic bacteria count from 36,200,000 to 197,000 per milliliter of saliva. On the other hand, parenterally administered penicillin did not reduce the aerobic bacteria count, which was 21,600,000 before and 23,600,000 after administration (Table 1). The counts just mentioned are for bacteria grown aerobically, but in-

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11. Bender, I. B.; Pressman, R. S., and Tashman, S. G. Studies on excretion of antibiotics in human saliva. I. Penicillin and streptomycin. J.A.D.A. 46:170 Feb. 1953.

Table 1

Effects of antibiotic preparations on bacterial population counts in the mouth

Antibiotic preparation	Cases	Av. no. bacteria (million per ml. of saliva)			
		Before administration of antibiotic		After administration of antibiotic	
		Aerobic	Anaerobic	Aerobic	Anaerobic
Sul Pondets troches	33	31.7	39.4	4.3	4.5
Wybiotic Troches	15	36.2	25.7	0.197	0.145
Penicillin (parenteral)	15	21.6	17.3	23.6	18.2

spection of the data shows that anaerobic bacteria counts were similar.

Wybiotic Troches apparently were somewhat more effective than Sul Pondets, but consideration must be given to the use of inactivators in the culture medium. The culture medium for the Sul Pondets group contained para-aminobenzoic acid and penicillinase to neutralize the continuing antibacterial effect of residual penicillin during the period of incubation. There is no known neutralizing agent for the antibiotics in Wybiotic Troches.

Table 2

Penicillin levels (units per milliliter) one hour after administration of fortified penicillin (parenteral)

Serum	Saliva
2.0	0.028
4.0	0.020
1.4	0.008
0.8	0.006
2.2	0.006
3.2	0.006
3.2	0.008
2.4	0.014
4.8	0.011
3.3	0.025
1.2	0.013
2.2	0.022
2.4	0.022
1.9	0.006
4.2	0.008
2.9	——
2.4	——
1.6	——
1.3	——
No. cases 19	15
Averages 2.5	0.014

The apparent ineffectiveness of parenterally administered penicillin on bacteria in the saliva is explained by the fact that the amounts of penicillin excreted into the saliva (Table 2) are sublethal.[10]

SPECIFIC ORGANISMS IN SALIVA—The types of organisms found in the saliva before and after administration of each antibiotic preparation and the percentage of saliva samples in which each was found are summarized in Table 3. Sul Pondets and Wybiotic Troches brought about a general reduction in number of all bacteria for most patients. The *Streptococcus viridans* (group) and *Streptococcus beta hemolyticus* seemed most susceptible and were completely eliminated in many of the individual counts. The *Streptococcus anhemolyticus* appeared less susceptible to the antibiotics, and although their number was greatly reduced they were not completely eliminated. Penicillin had some effect in eliminating *Str. viridans* and the pneumococci, but very little effect in reducing the remainder of the general bacterial population.

BLOOD CULTURES—Before extraction of teeth, blood cultures of all patients were negative.

Immediately after extraction of teeth,

Table 3

Organisms recovered from mouth before and after administration of antibiotic preparations

Organisms	Percentage of saliva samples yielding various organisms*					
	Sul Pondets		Wybiotic		Penicillin (paren.)	
	Before	After	Before	After	Before	After
1. Streptococcus viridans (group)	72 (24)†	48 (15)	53 (33)	27 (20)	66 (26)	40 (40)
2. Str. anhemolyticus	79 (93)	72 (87)	27 (80)	33 (60)	80 (86)	93 (86)
3. Str. beta hemolyticus	21 (24)	9 (18)	13 (20)	20 (20)		
4. Str. faecalis	3 (0)	3 (0)				
5. Staphylococcus albus nonhemolyticus	12 (21)	9 (6)	20 (0)	0 (0)	26 (20)	20 (6)
6. St. albus hemolyticus					0 (0)	6 (0)
7. Diplococcus pneumoniae	33 (24)	21 (15)	27 (20)	27 (6)	60 (33)	40 (13)
8. Diphtheroid bacilli	48 (54)	36 (41)	86 (86)	66 (73)	60 (93)	60 (80)
9. Micrococcus tetragenus	76 (3)	69 (6)	73 (6)	46 (20)	93 (13)	93 (13)
10. M. flava			0 (0)	6 (0)	13 (0)	13 (6)
11. M. catarrhalis	3 (0)	0 (0)				
12. Neisseria flava	15 (0)	3 (0)	0 (0)	6 (0)	20 (0)	13 (0)
13. N. catarrhalis	9 (6)	9 (0)	40 (40)	40 (27)	13 (13)	20 (0)
14. N. sicca	9 (0)	6 (0)	27 (27)	13 (0)		
15. Sarcina lutea			0 (0)	6 (0)		

*Percentages are based on 33 cases for the Sul Pondets series, 15 cases for the Wybiotic series and 15 cases for the parenteral penicillin series. Organisms no. 1, 2, 5, 7 and 8 consistently displayed individual high counts per milliliter of saliva at 10^{-5} dilution.

†Numbers in parentheses indicate percentage of saliva samples which yielded the organism under anaerobic conditions; numbers not in parentheses are the corresponding data for organisms grown aerobically.

84.9 per cent of all patients untreated with antibiotics developed bacteremia as indicated by the fact that one or more of their blood culture flasks showed bacterial growth. Only 40.5 per cent of patients treated preoperatively with Sul Pondets, 53.0 per cent of patients treated with Wybiotic Troches, and 53.1 per cent of patients given penicillin parenterally, had positive blood cultures immediately after extraction of teeth.

Blood samples taken ten minutes after extraction of teeth yielded positive cultures in 44.1 per cent of the control group, 8.1 per cent of the Sul Pondets group, 13.8 per cent of the Wybiotic group, and 26.7 per cent of the parenteral penicillin group (Table 4). In only a single instance did an anaerobic culture yield a positive result which had not also been detected aerobically.

SPECIFIC ORGANISMS—Table 5 summarizes the kinds of organisms found in the blood and the number of blood samples in which each was found. It can

Table 4

Effects of antibiotic preparations on postextraction bacteremia

	Immediately after extraction			10 minutes after extraction		
	Cases	No. positive cultures	Per cent positive cultures	Cases	No. positive cultures	Per cent positive cultures
Controls	93	79	84.9	93	41	44.1
Sul Pondets troches	37	15	40.5	37	3	8.1
Wybiotic Troches	30	16	53.0	29	4	13.8
Penicillin (parenteral)	32	17	53.1	30	8	26.7

Table 5

Organisms recovered from blood after extraction of teeth

Organisms	No. blood samples yielding various organisms*							
	Sul Pondets		Wybiotic		Penicillin		Totals	
	Immed.	10 min.	Immed.	10 min.	Immed.	10 min.	Immed.	10 min.
Streptococcus viridans (group)	5 (1)†	0 (0)	8 (3)	1 (0)	10 (4)	4 (2)	23 (8)	5 (2)
Str. anhemolyticus	3 (1)	1 (0)	3 (2)	1 (1)	2 (2)	0 (1)	8 (5)	2 (2)
Str. beta hemolyticus			1 (0)	0 (0)	1 (0)	0 (0)	2 (0)	0 (0)
Staphylococcus albus nonhemolyticus	1 (1)	1 (0)			1 (0)	0 (0)	2 (1)	1 (0)
St. albus hemolyticus	3 (1)	0 (0)			1 (1)	1 (0)	4 (2)	1 (0)
Diplococcus pneumoniae	1 (0)	1 (0)			2 (0)	0 (0)	3 (0)	1 (0)
Diphtheroids	5 (0)	1 (0)	4 (2)	0 (0)	7 (5)	2 (0)	16 (7)	3 (0)
Neisseria flava					4 (3)	1 (2)	4 (3)	1 (2)
N. catarrhalis	1 (0)	0 (0)	1 (0)	0 (0)			2 (0)	0 (0)
Micrococcus tetragenus			0 (1)	0 (0)			0 (1)	0 (0)

*All controls (samples of blood taken preoperatively) were negative; they are not shown in this table.

†Numbers in parentheses indicate number of times organisms were recovered under anaerobic conditions in the blood; numbers not in parentheses give corresponding data for organisms grown aerobically.

be seen that seven types of organisms were isolated under aerobic conditions from the blood taken immediately after operation from patients who had received a Sul Pondets troche. Under anaerobic conditions, only four types of organisms were isolated, none of them different from those obtained aerobically. Eight out of 15 positive cases manifested a streptococcemia either alone or in combination with other bacteria under aerobic conditions, two out of four under anaerobic conditions. Blood samples collected ten minutes later yielded no organisms not already found in the blood taken from the same patients with a single exception.

DEGREE OF TRAUMA—The incidence of bacteremia was related to the degree of trauma. Table 6 shows that mild trauma was followed immediately by bacteremia in 68.7 per cent of the control patients; severe trauma was followed by bacteremia in 93.4 per cent of the control patients. Blood cultures of samples withdrawn ten minutes later showed less clear-cut differences—34.3 per cent positive after mild trauma, 49.2 per cent positive after severe trauma.

Sul Pondets was effective in preventing bacteremia after mild trauma; all blood cultures were negative. It had some effect in preventing bacteremia after severe trauma; it reduced the incidence of bacteremia from 93.4 per cent (control) to 62.5 per cent immediately after extractraction, and from 49.2 per cent to 12.5 per cent ten minutes after extraction (Table 6). These results were statistically significant.

Examination of the data shows similar but less decisive results from the use of Wybiotic Troches—some reduction in the incidence of bacteremia after mild trauma, a smaller reduction after severe trauma. The reduction in percentage of bacteremia for grade 1 trauma was not statistically significant. This discrepancy cannot be explained, although it may be attributed to the smaller number of patients in this group.

Parenterally administered penicillin, like Sul Pondets, reduced the incidence of bacteremia after mild trauma to a

statistically significant degree. Its effect on the incidence of bacteremia after severe trauma was little or none, and it had practically no effect on the incidence of bacteremia detected in blood samples taken ten minutes after severe trauma (40.0 per cent positive blood cultures in the penicillin group as against 49.2 per cent in the control group).

■ *Discussion*

GINGIVAL SULCUS AS SOURCE OF BACTERIA—This study substantiates Burket and Burn's theory that the gingival sulcus is the source of the bacteria in postextraction bacteremia. The following evidence is offered: (1) the kinds of organisms which were isolated from the blood of a patient were nearly always the ones which were found in highest amounts in his saliva; (2) locally applied antibiotics which reduced the bacterial population of the saliva also reduced the incidence of bacteremia and (3) a greater degree of trauma in the gingival sulcus was followed by a greater incidence of bacteremia.

1. The *Str. viridans* (group) found most frequently and in largest number in the saliva was also found most frequently in the blood. If a combination of organisms (for instance, diptheroids and streptococci) had a high population count in the saliva, the same combination was frequently found in the corresponding blood samples. Rarely was an organism recovered in the blood which had not been found in the saliva; however, *Str. anhemolyticus* was not found as frequently in the blood as might have been predicted from population counts and frequency of appearance in the saliva.

2. Sul Pondets troches, which reduced bacteria counts in the saliva from 31.7 million per milliliter to 4.3 million per milliliter, reduced the incidence of bacteremia from 84.9 per cent to 40.5 per cent. Wybiotic Troches, which reduced saliva bacteria counts from 36.2 million per milliliter to 0.197 million per milliliter, reduced the incidence of bacteremia from 84.9 per cent to 53.0 per cent. Parenterally administered penicillin had no effect on

Table 6

Degree of trauma and effectiveness of antibiotics against bacteremia

Treatment	Grade of trauma	Total cases	Immed. aft. extraction			10 min. aft. extraction		
			No. pos.	% pos.	P*	No. pos.	% pos.	P
Control	1	32	22	68.7	—	11	34.3	—
	2	61	57	93.4	—	30	49.2	—
Penicillin parenteral	1	12	2	16.6	0.006	0	0.0	0.05
	2	20	15	75.0	0.06	8	40.0	0.62
Sul Pondets troche	1	13	0	0.0	<0.001	0	0.0	0.04
	2	24	15	62.5	0.001	3	12.5	0.004
Wybiotic Troche	1	19	9	47.4	0.22	2†	11.1	0.19
	2	11	7	63.6	0.02	2‡	20.0	0.05

*P is probability (0.05 or less indicates significant difference due to treatment).
†Based on 18 cases.
‡Based on 10 cases.

the bacteria count in the saliva. The sublethal amounts of penicillin excreted in the saliva may weaken the organisms (Eagle's theory) so that they are destroyed more readily by the phagocytes in the blood.[12] This would explain the rapidity with which the penicillin acts against the bacteria of postextraction bacteremia, as antibiotics ordinarily do not have an immediate effect on bacteria.

3. The rupture of capillaries in and around the gingival sulcus provides the means of egress of the bacteria from the gingival sulcus into the blood stream. Extensive capillary rupture (in severe trauma) was followed by a high incidence of bacteremia (93.4 per cent); less extensive capillary rupture (in mild trauma) was followed by a lower incidence of bacteremia (68.7 per cent).

COMPARISON OF ANTIBIOTIC PREPARATIONS—All three antibiotic preparations reduced the incidence of bacteremia immediately after mild trauma; Sul Pondets ranked highest in effectiveness, followed by Wybiotic Troches and parenteral penicillin. The antibiotics had a lesser effect on the incidence of bacteremia immediately after severe trauma; Sul Pondets ranked highest, followed by Wybiotic Troches; parenteral penicillin was ineffective.

Evaluation of the effectiveness of the antibiotics as measured on blood samples taken ten minutes after tooth extraction should take account of the natural antibacterial action of the blood. This action reduces the incidence of bacteremia in untreated patients almost by half during that period. On this basis, Sul Pondets can be regarded as having a statistically significant effect; the effectiveness of Wybiotic Troches is less than that of Sul Pondets. The incidence of bacteremia in patients receiving parenteral penicillin fell within ten minutes from 53.1 per cent to 26.7 per cent, a reduction no greater than could be accounted for by the antibacterial action of the blood.

RULES FOR PREVENTION OF POSTEXTRACTION BACTEREMIA—A set of rules can be formulated from this and other studies which should be helpful in controlling postextraction blood stream infection, although there are no prophylactic measures which can be depended on entirely to prevent these complications which make oral surgery such a serious risk for patients with heart damage:

1. Manipulation of the gums or teeth should be avoided whenever possible in patients known to have congenital malformations of the heart or to have suffered from disease likely to damage the endocardium. Root canal therapy, if at all feasible, is preferable to tooth extraction because it produces less trauma. (Subacute bacterial endocarditis has never been reported after endodontic treatment.)[13]

2. Before extraction or other oral surgical procedures, all patients should be questioned closely to elicit a history of any disorder of the heart, rheumatic fever, scarlet fever, pains in the joints, "growing" pains, frequent "sore throats," or chorea.

12. Eagle, H. Symposium on antibiotics. Recovery of bacteria from toxic effects of penicillin. J. Clin. Investigation 28:832 Sept. (part 1) 1949.

13. Kolmer, J. A. Focal infection of dental origin in relation to disease. In Transactions of the World Conference on Endodontics, 1953, Grossman, Louis I., editor. Philadelphia, Stephenson Bros., 1953.

In the presence of any conditions suggesting rheumatic diathesis, the patient should be warned of the possible complications; he should be seen by a physician in consultation with the dentist before oral surgical procedures are begun.

3. Local anesthesia, with procaine hydrochloride, should be used in preference to general anesthesia; it has been generally observed that extraction may be performed with less trauma under local anesthesia. (Villardo[14] demonstrated increased bactericidal and phagocytic properties in the blood of rabbits, with enhancement of the antibacterial functions of the reticuloendothelial system, after subcutaneous injection of procaine.)

4. Only one tooth should be removed at a time. The tooth should be extracted with a minimum of rocking or trauma. Multiple extractions are contraindicated in these patients.

5. Antibiotics should be administered as follows:

a. One hour before extraction, a combination of 400,000 units of fortified penicillin and 1 Gm. of streptomycin should be administered intramuscularly.[15] Patients sensitive to penicillin may receive, in the same syringe, a parenteral antihistamine.

When antibiotics are administered by the intramuscular route, there appears to be no need to give the antibiotics 24 hours beforehand, as recommended elsewhere. Within 24 hours almost all of the antibiotic is eliminated from the blood stream.[11] Prolonged concentrations of antibiotics in the saliva may change the flora of the mouth to such an extent that the more resistant organisms would survive and thus may produce a bacteremia that would be more difficult to control.

b. One-half hour before extraction, one Sul Pondets or Wybiotic troche, depending on whether the patient is sensitive to penicillin, should be dissolved slowly in the mouth.

c. Twelve to 24 hours after extraction, for additional protection, an injection of 400,000 units of fortified penicillin and 1 Gm. of streptomycin may be given; penicillin may be continued by mouth as long as desired to prolong the concentration of the antibiotic in the blood stream. Oral administration of penicillin alone should not be depended on as a means of protection.

■ *Summary and Conclusions*

Methods of preventing postextraction bacteremia were tested by comparing the effects of two different antibiotic troches, applied locally to the mouth before tooth extraction, with the effects of preoperative injection of penicillin. Saliva samples collected before and after administration of antibiotics were examined for bacteria counts and identification of types of bacteria. Blood samples taken before, immediately after and ten minutes after tooth extraction, were cultured, and the types of organisms were identified. The following conclusions were drawn:

1. The theory that the bacteria of postextraction bacteremia are the normal inhabitants of the mouth which gain access to the blood stream through the

14. Villardo, S. Contributo allo studio dei fenomeni immunitari nell'anestesia locale novocainica; potere battericida e potere fagocitario del sangue. Gior. di batteriol. e immunol. 20:1201 June 1938.

15. Northrop, P. M. Preoperative management of the oral surgery patient. J. Oral Surg. 11:105 April 1953.

traumatized tissues of the gingival sulcus is confirmed.

2. The incidence of bacteremia can be reduced by reducing the degree of trauma.

3. Local application of antibiotics in the form of troches slowly dissolving in the saliva under the conditions outlined in this study can be more effective than intramuscular injection of penicillin in preventing postextraction bacteremia.

4. The antibiotic troches are effective in reducing the incidence of bacteremia after mild trauma, and are effective, although to a lesser degree, if the trauma is severe; penicillin administered by intramuscular route is effective if the trauma is mild, ineffective if the trauma is severe.

5. The most effective of the three antibiotic preparations tested was a troche containing penicillin, bacitracin, sulfadiazine and ethyl aminobenzoate. This troche, however, should be used as an adjunct, not as a substitute for, the parenteral administration of antibiotics.

6. If sensitivity to penicillin is a factor, the troches containing neomycin, polymyxin B sulfate and zinc bacitracin can be used.

7. A set of rules is outlined to protect patients with heart damage against the subacute bacterial endocarditis which so often is a sequel of oral surgery.

■ The Fitness of Technical Terms

So far as individual words are concerned, they prove their fitness by surviving, and if they do survive, little more can be said. They may be unattractive, they may be illogical, but if they make their way, neither taste nor logic can furnish much opposition. Antibiotic is neither very attractive nor very clear, but it seems to be well established. Would anyone seriously urge replacing hydrogen by protium because the latter is a logical mate for deuterium? It would be much if we could exclude words that are forbiddingly impersonal, the extreme hybrids and abbreviations which a recent writer, S. Potter, has aptly called "shadowy and inhuman devices appearing and disappearing in that strange border country which separates speech from the mathematical sciences." Where possible, technical terms should not be too closely crowded in any passage; they need a little air around them, unless their sole purpose is to convey information as impersonally as possible—a purpose that can be overdone. The most severely technical words have to consort with those of a less austere sort, and the judicious writer should pay some heed to making them get along amicably. *Charles E. Whitmore, "The Language of Science," Scientific Monthly 80:191 March 1955.*

Management of diabetes mellitus during oral surgical procedures

■ *Alan S. Cohen, M.D., Boston*

Diabetes mellitus is no longer a contraindication to any kind of surgery. The general statement is often made that the well-controlled diabetic patient gives no problem and that his surgical management is basically no different from that of the person who does not have diabetes.[1,2] Since diabetes is primarily a metabolic disorder, however, and since oral surgery and anesthesia may superimpose fluid and electrolyte imbalances, special attention should be given to the diabetic patient who is undergoing any surgical procedure.

Since the discovery of insulin, increasing numbers of persons with diabetes have received surgical treatment. Many factors are responsible: the foremost are longer survival among diabetic patients, the increasing incidence of diabetes in the general population and the development of safer surgical and anesthetic technics.[1]

The person with uncontrolled or newly discovered diabetes shows many pathologic changes in his teeth and alveolar structures.[3,4] These conditions improve considerably when the disease is well controlled. Some authorities believe that the oral hygiene of the well-regulated diabetic patient is better than that of the population as a whole.[3,4] Thus, it is important to obtain as close control as possible before submitting a diabetic patient to an elective oral surgical procedure. Exceptions sometimes must be made in emergencies.

When surgery is indicated in the person with diabetes, a medical examination should be an integral part of the management. The patient should be examined thoroughly for vascular diseases that might complicate the procedure. It is recommended that patients routinely have a complete urinalysis, and their blood chemistries should be determined on admission to the hospital.

■ *Diagnosis*

The mere presence of sugar in the urine does not always indicate that diabetes is present. In a study carried out in 1946 based on screening of 3,186 persons in Brookline, Mass., by the U. S. Public Health Service, it was shown that of 112 persons with glycosuria who were retested,

Delivered before the annual senior staff meeting, oral surgery department, Boston City Hospital, Boston, October 1954.

From the diabetes field research and training unit, Division of Special Health Services, Public Health Service, Department of Health, Education and Welfare; Thorndike Memorial Laboratory, 2nd and 4th medical services (Harvard), Boston City Hospital, department of medicine, Harvard University Medical School; and the diabetes service, Boston City Hospital.

1. Shuman, C. R. Management of diabetes mellitus in patients undergoing surgery. J.A.M.A. 155:621 June 12, 1954.

2. Pratt, T. C. The diabetic as a surgical risk. Bull. New York Acad. Med. 26:786 Dec. 1950.

3. Knishkowy, E.; Person, P., and Pollack, H. Mouth in diabetes mellitus. J. Mt. Sinai Hosp. 17:192 Sept.-Oct. 1950.

4. Zilz, J. Statistical observations on diabetes and pyorrhea alveolaris. D. Cosmos 57:102 Jan. 1915.

only 35.7 per cent had diabetes.[5] Low renal threshold and the presence of other reducing substances in the urine certainly are factors to be taken into consideration. The urinalysis is to be regarded as a rough screening procedure, and only through measurement of blood sugar levels can a diagnosis of diabetes mellitus be made.

The criteria used at the Boston City Hospital diabetes clinic are listed in Tables 1 and 2. The blood sugar values are always determined on venous blood.

■ *Treatment*

When the diagnosis is established, the preoperative and postoperative treatment of the diabetic patient should consist of both diet and insulin. The patient's caloric intake and distribution must be carefully calculated. Diet control can be facilitated by a meal planning system such as that advocated by the American Diabetes Association and the U. S. Public Health Service.[6] It should be emphasized that adequate nutrition is important; therefore, diets below 1,800 calories are not usually recommended until the patient recovers from the surgical procedure. In the malnourished patient, high protein feeding may be indicated and can be given as eggnogs or as high protein drinks, that is, milk with added dry skim milk and flavoring. Although it is often possible to control the patient with mild diabetes on diet alone, insulin therapy should be instituted whenever a surgical procedure is contemplated. The insulin therapy assures more adequate metabolic balance and favors tissue healing.

5. Harting, D., and Glenn, B. Comparison of blood-sugar and urine-sugar determinations for detection of diabetes. New England J. Med. 245:48 July 12, 1951.

6. Calculation of diabetic diets: report of committee on diabetic diet calculations, American Dietetic Association. Prepared cooperatively with committee on education, American Diabetes Association, and diabetes branch, U. S. Public Health Service. J. Am. Dietet. A. 26:575 Aug. 1950.

Table 1

Boston City Hospital criteria for interpretation of fasting and postprandial venous blood sugar in diagnosis of diabetes mellitus

Time	Blood sugar values in mg. per 100 ml.		Interpretation
	Somogyi-Nelson "true blood sugar"*	Folin-Wu "total reducing substances"†	
After fasting	110 or more	130 or more	Diabetes usually present‡
	90—109	110—129	Further study needed§
	Less than 90	Less than 110	Diabetes usually absent
Two hours after eating	160 or more	180 or more	Diabetes usually present‡
	120 to 159	140 to 179	Further study needed§
	Less than 120	Less than 140	Diabetes usually absent

*Nelson, N. Photometric adaptation of Somogyi method for determination of glucose. J. Biol. Chem. 153:375 May 1944.

†Haunz, E. A., and Keranen, D. C. Clinical interpretation of blood sugar values. Proc. Am. Diabetes A. 10:200, 1950.

‡Results should be confirmed by postprandial blood sugar or glucose tolerance test.

§Postprandial blood sugar or glucose tolerance test should be repeated.

Table 2

Criteria and interpretation of 100 Gm. oral glucose tolerance test*

Criteria		
Time after glucose	Minimum reading considered positive in mg. per 100 ml.	
	Somogyi-Nelson	Folin-Wu
Fasting	110	130
1 hour	170	200
2 hours	120	140
3 hours	110	130

Interpretation†
If three or four hourly readings equal or exceed minimum values shown above, diabetes is present.
If one or two hourly readings are positive, potential diabetes may be present.
If no readings are positive, diabetes is absent.

*Patient is prepared by adequate carbohydrate intake of 200 Gm. or more for three days and an overnight fast before test.

†Interpretation adapted from that used in diabetes studies of U. S. Public Health Service after consultation with specialists.

If the patient's condition is not well controlled or the degree of control is not known, the amount of insulin must be adjusted to the patient's need and the degree of control evaluated. For example, on the first day the patient is started on 10 to 20 units of isophane insulin (NPH, or Neutral Protamine Hagedorn) with the addition of regular insulin as indicated by such factors as presence of symptoms, level of blood sugar, amount of glycosuria, amount of acetonuria and the nutritive status of patient. The second day, two-thirds the total dose of NPH and regular insulin are given as the morning dosage, and regular insulin is given during the day. This routine is continued until control is established; this period usually takes only a few days.

Table 3 shows the various kinds of insulin by time of effective onset, peak and total duration of effectiveness. NPH, a long-acting insulin preparation, has been effective in the routine management of diabetes and will control approximately 75 per cent of the diabetics on insulin.[7] A single dose before breakfast will regulate the majority of patients.[8] Supplementary doses of regular insulin may be necessary in some patients.

■ *Preoperative Care*

As has been noted earlier, a general medical examination is always in order in the person with diabetes, since the incidence of vascular complications is high. Kent has stated that in some clinics it is believed, with regard to dental extractions, that if infection and periodontal disease are present, not more than one or two teeth should be removed at a sitting.[9]

At the Boston City Hospital,[10] experience has shown that, in the properly controlled patient, even a full mouth extraction can be carried out with little in-

7. Beaser, S. B. Medical progress: diabetes mellitus. New England J. Med. 247:397 Sept. 11, 1952.

8. Shuman, C. R., and Francis, R. B. NPH insulin in diabetic patients with complications. Am. J. M. Sc. 222:169 Aug. 15, 1951.

9. Kent, H. A. In Treatment of diabetes mellitus, ed. 9. Joslin, E. P., and others. Philadelphia, Lea & Febiger, 1952.

10. Mallett, S. Personal communication.

creased hazard to the patient. The patient's clinical condition must be assessed carefully; in a survey of 108 instances of diabetic coma, two were precipitated by procedures about the mouth.[11] In the presence of infection, cultures and institution of suitable antibiotic therapy preoperatively and postoperatively are indicated.

The poorly controlled patient should never be operated on until the internist has had an opportunity to control the diabetes. The exception to this rule might be the patient with a large oral abscess in whom control would be exceedingly difficult until this focus of infection is drained.

■ *Preoperative Insulin*

When the manipulations about the mouth are not of great magnitude and last less than one hour, the patient is kept on his usual dose of long-acting insulin. If the surgery is to be of greater magnitude and general anesthesia is to be used, he is given one half of the dosage of long-acting insulin as usual in the morning and the other half on his return from the operating room. Slow infusions of 1,000 cc. 5 per cent dextrose in water should be started before the operation and allowed to run very slowly (six to eight hours). The addition of supplementary regular insulin and additional fluids sometimes may be necessary. It is not possible in this article to state general rules regarding dosage, for it will depend on the severity of the diabetes, preoperative nutrition, fluids given, type of anesthesia used, usual dose of insulin and many other factors. In some surgical services it is the practice to convert the patient's dose of insulin from long-acting to regular in divided doses at regular six-hour intervals.[12] At Boston City Hospital it seldom has been found necessary to do so during the routine oral surgical procedures.

■ *Anesthesia*

Diabetes *per se* should not be a contraindication to whatever specific anes-

11. Baker, T. W. Clinical survey of 108 consecutive cases of diabetic coma. Arch. Int. Med. 58:373 Sept. 1936.

12. Duncan, G. G., and others. Diabetes mellitus: principles and treatment. Philadelphia, W. B. Saunders Co., 1951.

Table 3

Time of action of various insulin preparations, in hours after injection*

Type of insulin	Effective onset	Peak	Total duration
Regular (crystalline or amorphous)	1–2	3–4	4–6
Isophane insulin (NPH, or Neutral Protamine Hagedorn)	4–5	12–16	20–24
Protamine zinc insulin (PZI)	6–10	16–20	20–30
Globin insulin	2–4	10–16	16–20
Lente insulin (zinc insulin) (suspension)	4–5	12–16	20–24

*Modified from Asche, B. Present status of various types of insulin and recommendations concerning their use. New York State J. Med. 53:2761 Dec. 1, 1953.

thetic agent is desirable. Although it has been demonstrated that anesthesia alone in major surgery will elevate the blood sugar level, the rise is not hazardous.[13] Local anesthesia is often preferable in oral surgery.[14-17] Some reports state that epinephrine should not be used in the local anesthetic because of the potential danger of its raising the blood sugar through the breakdown of liver glycogen. In the dosages commonly used, however, this would be of little consequence.[18]

■ *Postoperative Care*

When the patient returns from the operating room, he is given the remainder of his insulin, and fluids are continued by the intravenous or oral route as indicated. He is put on his regular diet as soon as feasible. If the patient can take no solid food, a liquid diet enriched with protein supplements can be given at the proper intervals. On the morning after surgery, the usual dose of long-acting insulin is resumed.

It should be remembered that if the patient has foci of infection that are being removed, it is possible that his insulin requirement will diminish in 12 to 14 hours. He therefore should be observed closely for insulin reactions and his insulin dose adjusted. The patients always should be on diets that provide them with continued adequate caloric intake. Debilitated patients undergoing any kind of surgical procedure will have their recovery delayed if their diet is not adequate. The mere fact that a patient is diabetic does not imply that he must be on a low calorie diet; adjustments must be made to meet the total body needs.

The person with diabetes that is well controlled medically will present few problems to the oral surgeon, but it is the responsibility of both internist and surgeon to observe their patient closely so that no complications arise.

■ *Summary of Procedure at Boston City Hospital*

The preoperative procedure at Boston City Hospital for patients undergoing oral surgical procedure is as follows:

1. Routine examinations, including urinalysis and blood sugar determinations, are made.
2. The status of diabetes is evaluated, and dietary and insulin therapy is administered as indicated.
3. The day before surgery, an extra 50 to 100 Gm. of carbohydrate is given.
4. No change in the administration of insulin is made for minor procedures lasting less than one hour.
5. In major operations lasting more than one hour with or without general anesthesia, one-half the daily dose of long-acting insulin and a slow intravenous infusion of 5 per cent dextrose in water are given.
6. Cultures should be made and antibiotics administered for infections.

The surgical management of the diabetic patient undergoing oral surgical

13. Griffiths, J. A. Effects of general anesthesia, and hexamethonium, on the blood-sugar in non-diabetic and diabetic surgical patients. Quart. J. Med. 22:405 Oct. 1953.
14. Burket, L. W. Oral medicine; diagnosis, treatment. Philadelphia, J. P. Lippincott Co., 1946, p. 412-422.
15. Thoma, K. Oral surgery, vol. 1. St. Louis, C. V. Mosby Co., 1948, p. 92, 93.
16. Mead, S. V. Oral surgery, ed. 3. St. Louis, C. V. Mosby Co., 1946, p. 116.
17. Northrop, P. M. Preoperative management of the oral surgery patient. J. Oral Surg. 11:105 April 1953.
18. Blaustein, S., and Ferguson, E. Dental cooperation in diabetes mellitus. J. Lab. & Clin. Med. 25:47 Oct. 1939.

procedures at Boston City Hospital is as follows:

1. Anesthesia is determined solely by surgical indications.

2. Diabetic patients should be scheduled for procedures early in the day whenever possible.

3. Surgical procedures should be carried out in regard to technic as if the patient were not diabetic.

The postoperative procedure at Boston City Hospital for oral surgical patients who have diabetes is as follows:

1. If the patient had a major procedure, slow intravenous administration of dextrose is continued.

2. The remainder of the daily dose of long-acting insulin is given with supplementary doses of regular insulin where indicated.

3. Oral feedings are given as soon as feasible—adequate caloric intake is important.

4. Frequent urinalysis (every four hours) and blood test for sugar (at least daily) are made.

5. The total usual dose of insulin is resumed the morning after the operation.

6. The regular diet also is resumed the morning after the operation has taken place.

■ ADVANCE OF SCIENCE

There seems to be a natural law that regulates the advance of Science. Where only observation can be made, the growth of knowledge creeps; but where laboratory experiments can be carried on, knowledge leaps forward. *Faraday.*

Roentgen ray therapy of the temporomandibular joint

■ *W. A. Goodrich, Jr.,* M.D., Baytown, Texas, and W. A. Johnson,† D.D.S., Temple, Texas*

The temporomandibular joint syndrome has been approached therapeutically from a number of directions. Regarding roentgen ray therapy, Foged[1] stated that "diathermy, short wave therapy, or radiotherapy sometimes produce temporary improvement." Doub and Henny[2] commented that "X-ray therapy will frequently give palliative relief, reducing inflammation sufficiently to allow correction of dental abnormalities." Bellinger[3] stated:

> Roentgen therapy has been used with mixed results. It is more often probable that the stage of development of the arthrosis is a determining factor in the response to roentgenographic treatment and other therapeutic measures.

Nowhere in the literature were the details of treatment or the results of a series of cases presented.

It is the purpose of this article to report the results of roentgen ray therapy of the temporomandibular joint in patients who had been treated at the Scott and White Clinic from 1946 to 1953. Fifty-five persons received therapy, and, of these, 45 furnished sufficient information for further study of the problem.

■ *Method*

Roentgen therapy was applied from a lateral position directly over the joint. Both superficial and deep therapy machines have been utilized (Fig. 1). The former type was operated at about its maximum setting. This was ordinarily 140 kilovolt peak with filtration of ¼ mm. copper plus 1 mm. of aluminum, giving a half-value layer of 0.44 mm. of copper or 9.0 mm. of aluminum. A distance of six inches (15 cm.) and a cone 4 cm. in diameter were standard. When 250 or 220 kilovolt peak machines were used, a filtration of 1 mm. of copper and 1 mm. of aluminum was routine, producing a half-value layer of 1.67 mm. of copper. Field size was 5 x 5 cm., with a target-skin distance of 50 cm. Doses calculated in air without back scatter have varied from 140 to 320 r. If the number of roentgens is calculated at a depth of 2 cm., the temporomandibular joints received 171 r for superficial and 192 r for deep qualities of irradiation from the average air dose of about 200 r. (Skin doses were 250 r to 300 r.)

Treatments were usually given in a single sitting, and only rarely has fraction-

*Formerly, resident in radiology, Scott and White Memorial Hospitals and the Scott, Sherwood and Brindley Foundation. At present, in private practice.

†Department of dental surgery, Scott and White Clinic.

1. Foged, J. Temporomandibular arthrosis. Lancet 2:1209 Dec. 31, 1949.

2. Doub, H. P., and Henny, F. A. Radiological study of the temporomandibular joints. Radiology 60:666 May 1953.

3. Bellinger, D. H. Present status of arthrosis of temporomandibular joint. J. Oral Surg. 6:9 Jan. 1948.

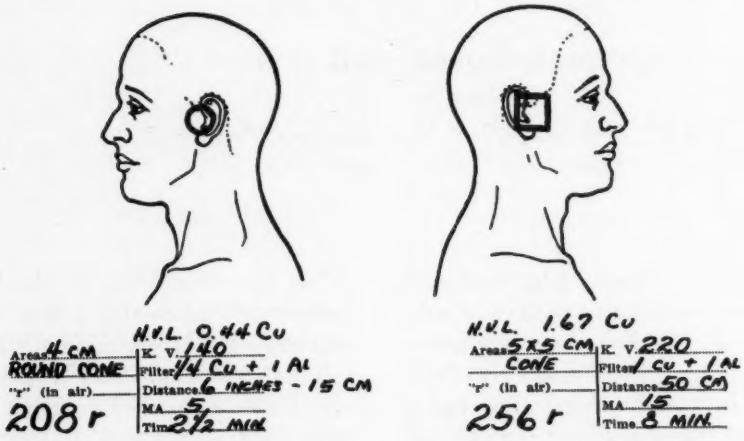

Fig. 1—Treatment card showing two technics employed

ation been deemed necessary. Not infrequently, a repeat treatment of the same factors has been given one to four weeks later to gain complete amelioration of symptoms.

In bilateral involvement, both joints have been treated the same day. This procedure has not resulted in demonstrable side effects.

The dental occlusion status of the patient was ascertained, and, when indicated, suitable restorative measures were advised. The number of patients who had acute or chronic temporomandibular joint disease related to abnormality of the bite, however, was not great. In the majority of instances there was acute onset of pain, usually with trismus, in a young to middle-aged person, without disordered occlusion. Deviation of the mandible to the involved side on opening was frequent, and occasionally slight swelling was present over the joint.

Roentgenograms were largely negative (Fig. 2, above), except for limitation of excursion of the condyle (Fig. 2, center) and some effusion. In some, excursion was normal, but considerable narrowing of the joint space indicated degeneration of the disk (Fig. 2, below).

Most of the patients were women: the ratio was 7:1.

■ *Results*

The results of this therapy in patients at the Scott and White Clinic are outlined in the table. Two groups were evident: (1) those patients whose condition was diagnosed positively as representing the temporomandibular joint syndrome and (2) those who were somewhat atypical but whose condition seemed representative of the syndrome. It became evident at an early date that a highly accurate diagnosis was essential and, thereafter, only well-selected cases were accepted.

Improvement was classified as good when largely complete and lasting. Partial

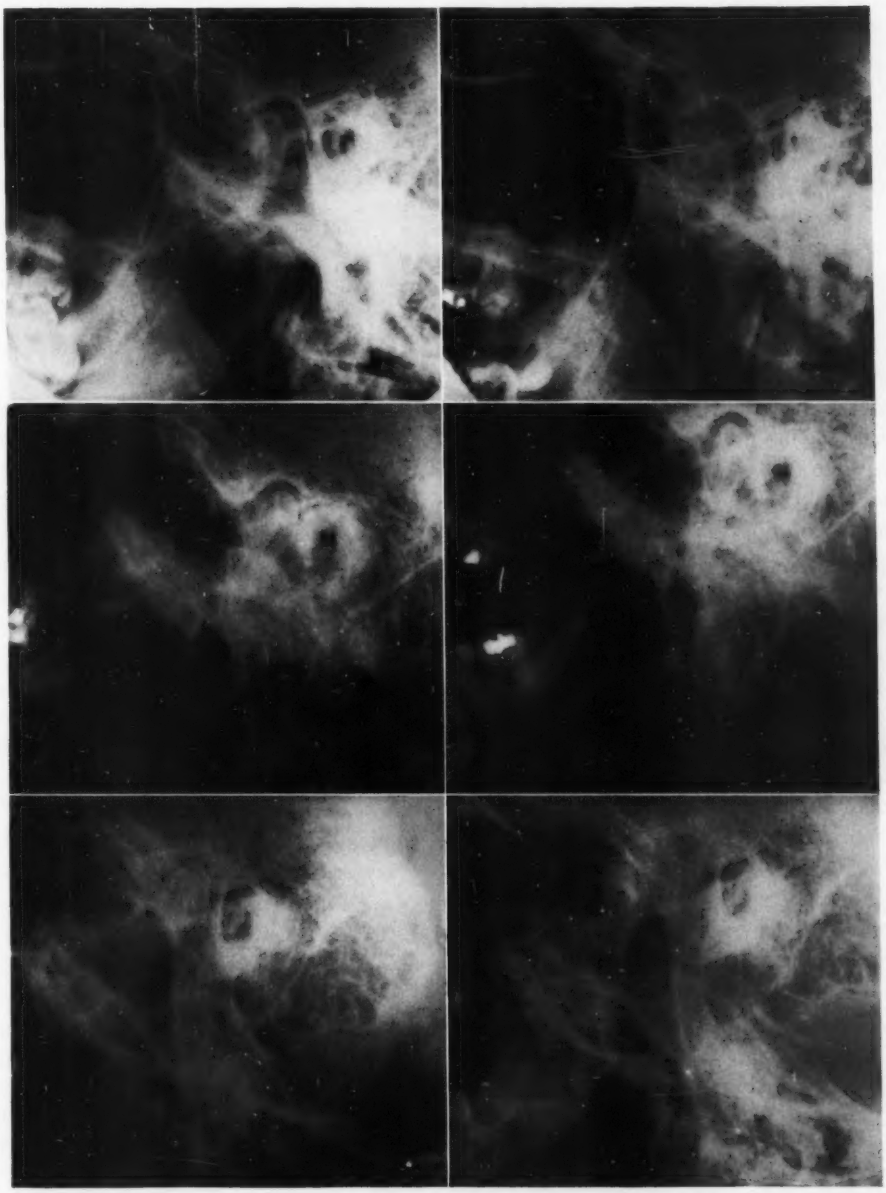

Fig. 2—Above: Normal temporomandibular joint, characteristic of most of the patients. Center: No excursion of condyle on opening mouth. Mandible will seem to deviate to this side. Below: Excursion normal; considerable narrowing of joint space indicates degeneration of disk

Table

Results of roentgen therapy of the temporomandibular joint*

	Good	Partial benefit	Failure	Total
Positive cases				
No. patients	27	5	4	36
Percentage	60	11	9	80
Presumptive cases				
No. patients	2	2	5	9
Percentage	4.5	4.5	11	20

*Follow-up on 45 patients.

benefit was used to indicate improvement of transient or incomplete degree, or when otherwise qualified by the patient. The importance of selectivity is obvious. The poor general results in the atypical patients argue for the specificity of treatment, and add a certain modicum of a control group for comparison with the remainder. Further, if the purely typical patients are considered as a single group, good results were obtained in 75 per cent, partial benefit in 14 per cent and no benefit in 11 per cent.

It was further apparent that, as in other joints, the acute symptoms in the temporomandibular articulation were much more responsive to roentgen ray therapy than were the chronic disorders. This is in complete agreement with Bellinger's impression. Effective results were obtained with all quantities of irradiation used. Hence, about 200 r (in air) has been adopted as the preferable dose. There is an impression that 140 r might not consistently produce an adequate effect. The difference between kilovoltages of superficial and deep therapy was not evident in the results.

■ *Discussion*

In roentgen ray therapy of the temporomandibular joint, care should be taken so as not to overlap unduly the parotid gland, as moderately large doses of irradiation might cause a transient mild parotitis. Although the temporomandibular joint syndrome is unlikely in children, caution should be used in treating any but adults, since some mandibular growth is manifest until the development of the third molars. The necessity of using a calibrated machine and an experienced therapist are obvious.

In our series, roentgen ray therapy was utilized primarily to relieve symptoms. Though the treatment of little understood diseases with roentgen therapy on a purely empirical basis has lately fallen into disrepute, this type of treatment aimed at rheumatic syndromes, such as periarticular fibrositis, bursitis, or "tendonitis" of the elbow, shoulder and so forth has been of value in the relieving of pain, increasing of mobility and dissolution of calcium deposits.[4]

Treatment with roentgen rays is not to be used to the exclusion of more standard methods. Physiologic rest of the temporomandibular articulation is the *sine qua non* in every instance. Malocclusion,

4. Leucutia, T. Treatment of diseases of the skeletal system, joints, and soft tissues. In Clinical therapeutic radiology, Portmann, U. V., editor. New York, Thos. Nelson & Sons, 1950, p. 530, 531.

when present, should be remedied. Heat, diathermy and salicylates aid further in symptomatic relief. Recently, compound F (hydrocortisone) for intracapsular injection has been available, and, as in similar arthropathies, it has produced excellent response in a short period of time.[5] Injection of sclerosing solutions has been used in certain selected cases with good results.

In chronic, refractory cases, radiation seems of less aid, though the number of these in our experience is too small to be significant. In such instances in which there are irreversible organic changes, an operation such as meniscectomy or condylectomy may be necessary.

■ *Summary*

Treatment of the painful temporomandibular joint with roentgen rays, using standard technic, has been undertaken. The results with 45 patients indicate that benefits of the same order as in bursitis or "tendonitis" of other joints may be anticipated.—*P. O. Box 26.*

5. Henny, F. A. Intra-articular injection of hydrocortisone into the temporomandibular joint. J. Oral Surg. 12:314 Oct. 1954.

■ Dangers of Active Ignorance

The appearance of science as a major social force has created many problems. We are justly proud of our American civilization. But how much scientific culture does Mr. Average American have? Our educational system has failed miserably in raising the culture of our people to an appreciation of the need of basic science. There is even less of what James B. Conant has called an "Understanding of Science."

Mr. Average American has not been taught to think critically or to weigh evidence. In the current controversy over the incorporation of fluorides in drinking water the public uses personal testimonials on the same basis as scientific evidence. Should our amusement not be tempered with sadness when we read "I found that drinking one bottle of Hadacol cured my rheumatism?" With even more sadness, we find some scientifically trained people thinking in the same fashion. . . .

In very few areas of our educational systems have the basic facts and methods of science been properly incorporated and taught. The result is that the majority of our people are scientifically "illiterate." This creates an extremely dangerous situation, anticipated by Goethe when he said, "There is nothing more frightful than an active ignorance." *Ward Pigman, "Wanted: More Ivory Towers," The Scientific Monthly 80:252 April 1955.*

A method for surgical closure of a perforation of the hard palate

■ *Jack B. Caldwell, D.D.S., M.Sc., San Francisco*

Defects in the continuity of the palate may be classified as congenital or acquired.

Acquired loss of palatal tissue may be a result of infectious disease, such as syphilis; inflammatory processes, such as osteomyelitis; or trauma, such as that caused by gunshot wounds. Occasionally a defect is created by surgical excision of a tumor. Often the excision of the tumor results in a loss of tissue so extensive that surgical repair is not feasible. If, however, sufficient soft tissue remains, local transposition may afford the patient a far more comfortable condition than can be furnished by means of prosthesis.

A case of oronasal perforation is reported in which plastic closure was accomplished in two stages, using a split-skin graft to line the palatal pedicle and thereby to furnish a skin lining for the floor of the nasal fossa.

■ *Report of Case*

A 21 year old white man was referred to the oral surgery section of the Walter Reed Army Hospital dental service on July 28, 1950, by the psychiatric service. His chief complaint was of a large perforating defect of the hard palate. On November 2, 1949, a tumor of the left side of the hard palate had been removed with the electrocautery knife at another hospital. Necrosis of a 3 by 1.5 cm. area of the left palatal process had followed, and when the sequestrum had been removed on January 10, 1950, a large oronasal communication had resulted. Surgical correction had not been considered advisable at the time, and a palatal obturator had been provided. Pathologists at the other hospital had diagnosed the excised tumor as a "mixed tumor of salivary gland origin." A consulting pathologist, however, had regarded it as an "epithelial tumor of a very low degree of malignancy." When reviewed by the Armed Forces Institute of Pathology, the tumor had been coded as "muco-epidermoid tumor, palate."

PAST HISTORY—Since the patient's enlistment in the Air Force in August 1947, he had spent a great portion of his time in various hospitals. His chief complaint, in most instances, had been recurrent gastrointestinal symptoms with pain, nausea and vomiting. He was admitted to the Walter Reed Army Hospital May 18, 1950, with a transfer diagnosis of "psychogenic gastrointestinal reaction."

Shortly after the patient's arrival, his gastrointestinal complaints became so severe that he was referred as an emergency patient to the gastroenterology section of the hospital. It was the opinion of

Colonel, Dental Corps, U. S. Army. Chief, oral surgery section, Letterman Army Hospital.

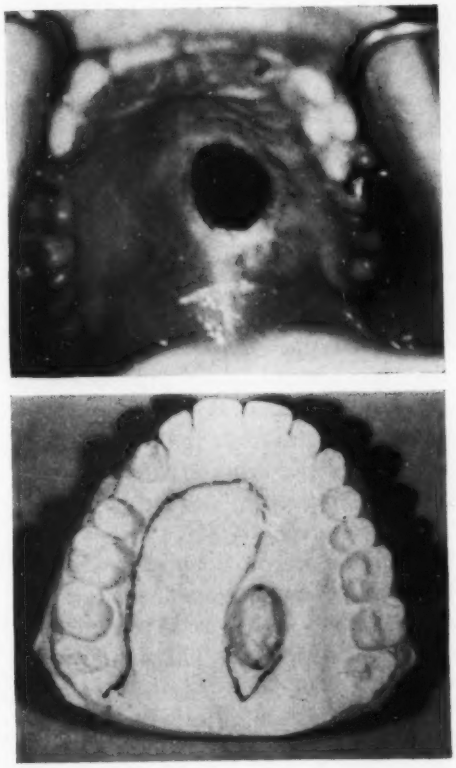

Fig. 1—Above: Perforating defect of hard palate. Below: Outline of pedicle flap on study model

the gastroenterologist that the patient had a pyloric obstruction. Roentgenographic and gastroscopic examinations and a gastric analysis were made of the upper gastrointestinal tract. The results of the examinations were normal. The patient responded to a soft diet, belladonna and phenobarbital, but he also responded to placebos.

After returning to the psychiatric service, the patient was accepted in the dental service for plastic correction of the surgical perforation of the hard palate, in the hope that such correction and elimination of the need for the palatal obturator might be of benefit. The patient was wearing this clear acrylic palatal obturator when first seen. Although not dissatisfied with the appliance, he was desirous of surgical correction to eliminate its necessity.

EXAMINATION RESULTS—Clinical examination revealed a large, perforating defect of the hard palate to the left of the midline (Fig. 1, above). This communication with the nasal cavity measured 20 mm., anteroposteriorly, and was 13 mm. wide. The nasal septum was intact. The mucosa of the septum, inferior turbinate and meatus appeared normal. There was no evidence of residual or recurrent tumor in the adjacent tissues, and the oral mucous membranes and gingiva were normal. A normal complement of teeth was present with the exception of an upper right first bicuspid. All the teeth were in good repair.

The results of the roentgenographic examination were not significant; those of the preoperative review and physical examination and laboratory studies were within normal limits.

Careful preoperative study was warranted, since with each surgical failure in palatal tissues, chances for successful closure of any defect are lessened. A study model was secured in order that measurement of tissue needs could be predetermined. The right side of the palate was decided on as an ideal donor site. A broad-based pedicle flap was outlined (Fig. 1, below). It appeared to offer the most adequate tissue source and blood supply. Right and left anterior palatine

nerves were anesthetized locally, and a needle exploration of the margins of the defect was made to ascertain the extent of underlying bone loss. It was determined that only a thin covering of mucosa existed.

TREATMENT AND COURSE—Rules of cleft palate surgery indicate that a lining should be provided for flaps transposed to the floor of the nasal cavity. To satisfy this requirement, closure in this instance was planned in two stages.

Stage 1 included the elevation of the pedicle flap and the attachment of a split-thickness of skin to its undersurface. The flap then was to be returned to the donor site. Stage 2 was to be delayed a sufficient time to allow the graft to "take" and also to improve the blood supply to the flap.

Stage 2 was planned to include transfer of the skin-lined pedicle flap to the freshened margins of the defect to be closed.

Administration of 300,000 units of penicillin, twice daily, was begun on July 31, in order that an adequate blood level would be established preoperatively.

OPERATIVE PROCEDURE (FIRST STAGE)—After the skin of the right thigh had been prepared and cleansed with pHisoderm, a 1:12,000 split-skin graft measuring 1½ by 2 inches was removed, and the large pedicle flap was elevated from the right side of the palate. This mucoperiosteal flap followed the outline previously determined. As the flap was reflected, the continuity of the anterior palatine vessels and nerves was preserved. Hemostasis was secured by the use of hot saline packs.

The skin graft was sutured with its raw surface to the raw undersurface of the flap, using no. 0000 plain catgut. Excess skin was trimmed away, leaving the edge of the flap bare. The skin-lined flap was replaced in its original position and was secured around the margins with interrupted no. 0000 chromic catgut sutures. A .016 stainless steel wire ligature then was threaded around the teeth and across the palate, much as a shoelace is placed. One-inch petroleum jelly gauze then was packed snugly under the wire network. Three no. 0 silk sutures were placed deeply through the packing at its posterior extent, tying it to the wire to prevent displacement into the oropharynx (Fig. 2, left).

On the fourth postoperative day the wire scaffolding and packing were removed. The flap had become readapted and appeared healthy. The sutures were removed.

By August 21, the twentieth postoperative day, the flap had healed completely. There appeared to be an excellent blood supply. When the flap was blanched with pressure, color returned immediately on release of the pressure. It was noted that the reattached flap had thickened considerably.

The patient was scheduled for the second stage of palatoplasty on August 24. Since a longer postoperative course had been anticipated for the second stage of surgery, with the result that the packing over the wound would be maintained for a longer period, a splint had been fabricated (Fig. 2, right). In this way there would be less packing and more tongue space, and the patient would be more comfortable.

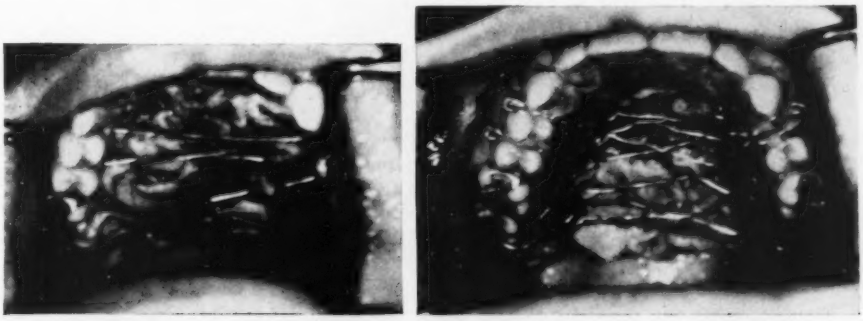

Fig. 2—Left: Petroleum jelly gauze packing after first stage of closure. Right: Packing under splint after second stage of closure

OPERATIVE PROCEDURE (SECOND STAGE)—An incision was made in a similar manner to that previously described, except that the incision was just inside the scar which resulted from the first stage of surgery. A v-shaped wedge of mucosa was excised just posterior to the palatal perforation (Fig. 1, below). The entire pedicle flap, including the previously attached skin graft, was elevated without difficulty, was turned on its broad base from the soft palate and was fitted to the perforation of the left side of the palate. Margins of the perforation were excised and a bevel was cut which extended 3 to 5 mm. into the adjacent mucosa. This wide, freshened border appeared to have an excellent blood supply, and the pedicle was seated into the prepared space. Four no. 0000 Dermalon mattress sutures were placed so as to assure a maximum contact of the raw tissue with the freshened borders of the perforation. None of the sutures was tied until all were in place and lack of tension and adaptation were assured. Several no. 0000 Dermalon interrupted sutures were added to augment closure.

The previously fabricated open palate splint was secured to the teeth. Petroleum jelly gauze was packed into the denuded region on the right side of the palate and over the transposed flap in such a manner that moderate pressure was maintained on the flap (Fig. 2, right).

The immediate postoperative course was uneventful except for bleeding, which was not sufficient to require repacking of the wound.

The splint was removed for the first time August 28, and the wound was inspected. The loops at the palatal periphery had impinged on the distal end of the flap, so that adjustment was necessary; otherwise the pedicle flap was well nourished and was attaching satisfactorily. The wound was repacked.

By the eighth postoperative day granulation over the denuded palatal process was excellent, and the transposed flap had a good color (Fig. 3, left). The sutures were removed, and the wound was re-dressed in the same manner as before. Thereafter the palate was inspected and re-dressed at three-day intervals. By September 6, 14 days after surgery, attach-

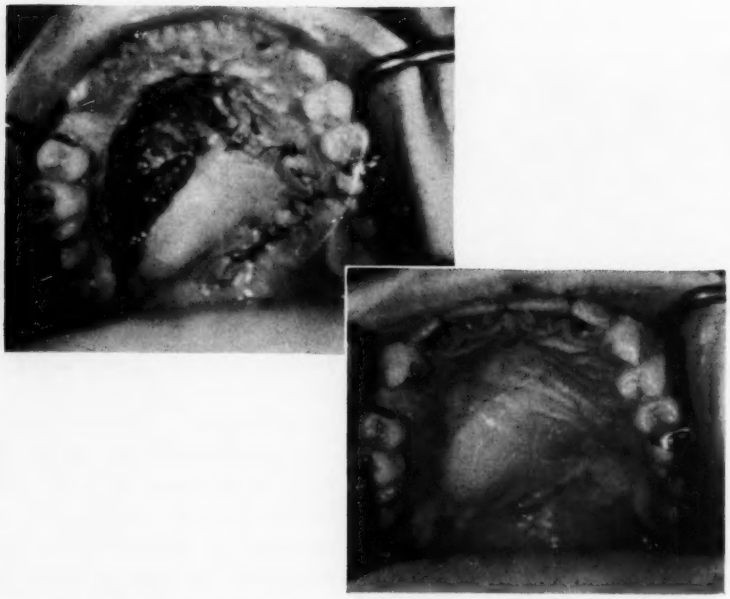

Fig. 3—Left: Well attached skin-lined pedicle flap when sutures were removed, eight days after second stage of closure. Right: Three months after second stage of closure

ment of the pedicle flap was assured. Granulation tissue was prolific in the open portion of the right side of the palate. By September 15, epithelization of the raw surface of the right side of the palate was well under way, and further dressing of the wound was not necessary. The patient was referred back to the psychiatric service.

Because of the administrative delay connected with a medical discharge from the service, it was possible to follow this patient for two additional months. By November 29, scarring was almost obliterated (Fig. 3, right). Rugae had begun to re-form. Normal mucosa covered the entire region from which the flap had been taken. The transposed pedicle flap was still prominent and thickened, but there was no speech impediment. The patient was completely satisfied with the result. He was discharged shortly thereafter, and no further examination was possible. It is expected, however, that complete re-formation of the rugae will take place and that in due time the flap will become less thickened and may eventually lose its identity.

■ *Summary*

Excision of a muco-epidermoid tumor of the palate with electric cautery had caused a large oronasal communication. The perforation of the hard palate was closed surgically in two stages. In the first stage a skin graft was supplied as a lining

to a large pedicle flap from the opposite side of the palate. In the second stage, which was performed three and one-half weeks later, the pedicle flap was transposed for closure.

The successful result is attributed to the adherence to the rules of cleft palate surgery and to careful preoperative planning, as well as to postoperative care of the wound.

Rebuilding the resorbed alveolar ridge

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Stability of dental prosthetic appliances has been a major problem confronting the dental profession since the replacement of missing teeth was first attempted. Improvement of technics and materials, and superior knowledge of the physiology and anatomy of the mouth have greatly reduced these problems. There is a small percentage of patients, however, who have lost so much alveolar ridge bone that comfortable, functional dentures are extremely difficult to construct. Unsatisfactory alveolar ridges can be created by injudicious surgery, advanced periodontal destruction prior to extraction of the teeth, or excessive atrophy from ill-fitting dentures. To cope with this problem many novel technics have been devised.

Spiral springs attached to the posterior borders and connecting the maxillary and mandibular dentures bilaterally was an early method employed to increase full denture stability.[1] In patients where mutilation has occurred because of extensive surgery to eradicate tumors, or because of trauma, spiral springs can still be used advantageously. The suction cup came into use shortly after the process for making vulcanite dentures was developed. This method for increasing stability has been almost universally discontinued; nevertheless, a vast amount of adhesive denture powders still is used in modern dentistry.

The opinions or assertions contained in this article are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

This research project was conducted at the Naval Dental School in conjunction with the Tissue Bank of the Naval Medical School and the experimental surgery section of the Naval Medical Research Institute.

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1. Warren, George W. A practical treatise on mechanical dentistry, ed. 7. Philadelphia, Blakiston Co., 1900. p. 252-54.

In 1809 Magilio reported the use of a metallic implant in the alveolar ridge to which a single tooth crown was attached.[2] This method of restoration was soon discarded, but modifications of the metal implant were revived in 1889, in 1913, and again in 1949.

In 1949 Goldberg and Gershkoff reported the use of a metallic implant for stabilization of a full denture.[3] It is interesting to note that these authors used the same reasoning to justify this procedure that Greenfield[2] used in 1913 when he reported the use of a latticed cylinder of iridioplatinum as an artificial root to which a single tooth crown was attached. Greenfield informed his critics that he had seen an orthopedic surgeon use a metal plate as a direct fixation appliance in the treatment of a fractured leg. He reasoned that the orthopedic procedure of plating and the oral surgical procedure of artificial root implantation were not sufficiently different to cause concern regarding exfoliation of the metal implant.

Recently, however, Nichols[4] has reported the results of his experimental work with metallic implants in dogs from which he concluded that the practice of utilizing semiburied denture implants should be re-evaluated by the dental profession.

This article presents the results of a study conducted to evaluate the use of freeze-dried homogenous tissues for rebuilding resorbed alveolar ridges.

During World War II the bone bank became an integral part of many hospitals in the armed services. The bone bank proved to be a valuable adjunct in the treatment of war injuries. The results obtained from the use of homogenous bone caused an increased interest in the study of osteogenesis as manifested by many investigators. Kruez and Hyatt[5] and their co-workers at the Naval Medical Research Institute, National Naval Medical Center, developed a freeze-drying process for banking homogenous bone which they reported in 1951. They stated:

> This process consists of freezing the bone and drying it under high vacuum. . . . as a result the dried bone is porous, with a friable sponge-like structure. Cancellous bone crumbles easily, while cortical bone is rigid and inelastic. Both types of bone are reconstituted to normal physical properties in fluid, whether it be saline, plasma, or the patient's hematoma.

The freeze-drying process was soon utilized to preserve other tissues.[6] At present all homogenous tissue used at the National Naval Medical Center is prepared by this method. Freeze-dried homogenous bone used in selected cases has certain advantages as compared with fresh autogenous bone.[7]

■ *Investigation*

The study herein described was conducted at the Naval Dental School in conjunction with the Tissue Bank of the Naval Medical School and the Experimental Surgery Section of the Naval Medical Research Institute. Edentulous

2. Greenfield, E. J. Implantation of artificial crown and bridge abutments. D. Cosmos 55:364 April 1913.

3. Goldberg, N. I., and Gershkoff, Aaron. Implant lower denture. D. Digest 55:490 Nov. 1949.

4. Nichols, Frederick C. Semiburied denture implants; review of literature and experimental study. J. Oral Surg. 12:217 July 1954.

5. Kruez, F. P., and others. Preservation and clinical use of freeze-dried bone. J. Bone & Joint Surg. 33-A:863 Oct. 1951.

6. Hyatt, G. W., and others. New methods for preserving bone, skin and blood vessels. Postgrad. Med. 21:239 Sept. 1952.

7. Blackstone, C. H. Freeze-dried bank bone and its application in clinical oral surgery. Mil. Surgeon 114:437 June 1954.

alveolar ridges in dogs were rebuilt by grafting freeze-dried homogenous aorta, bone, and cartilage. Forty-five grafting procedures were performed. The dogs were adult males of the same relative size. The average weight was 40.8 pounds. Under surgical aseptic conditions, the dogs' mouths were prepared for grafting by removing four mandibular teeth (Fig. 1, above). A complete buccolingual section of the mandible was then excised from the crest of the alveolar ridge inferiorly to the mandibular canal (Fig. 1, left). The vertical dimension of the bone that was removed varied from 7 to 11 mm.

■ *Method*

AORTA—The freeze-dried aorta was prepared for use by reconstituting in sterile normal saline solution. It was then cut in lengths of approximately 3 cm. Four pieces of a single thickness of aortic wall were sutured together with no. 00 chromic gut, thus forming a graft varying in thickness from 7 to 10 mm. Fourteen grafts of freeze-dried homogenous aorta were performed.

Ten aortic grafts were placed using an intraoral approach. Nine of these grafts were placed immediately after removal of the teeth and preparation of the graft bed. One intraoral graft was performed after the prepared graft bed had healed completely. The aorta was placed in the prepared bed, and the buccal and lingual mucoperiosteal flaps were approximated overlying the graft. The wound was closed with interrupted no. 000 monofilamentous nylon sutures.

Four aortic grafts were placed using an extraoral approach after the prepared graft bed had completely healed. An incision was made under the lower border of the mandible. The mandible was exposed by sharp and blunt dissection. The periosteum was elevated, and the graft was placed subperiosteally in the previously prepared graft bed. The wound was closed in layers. Plain no. 0000 catgut was used for deep sutures, and the skin was approximated with no. 000 monofilamentous nylon. A single layer of sterile mesh gauze was placed over the incision and secured with collodion.

BONE—Thirteen homografts of freeze-dried bone were performed. These grafts were all placed from an intraoral approach. This homogenous bone was reconstituted in sterile normal saline solution. It was then contoured to fit the prepared graft bed. The grafts were all comparable in size, approximately 3 cm. long, 4 to 8 mm. thick, and slightly narrower than the buccolingual dimension of the alveolar ridge. Seven grafting procedures were carried out immediately after extraction of the teeth and preparation of the graft bed. Six grafts were done when complete healing had occurred after the extraction of the teeth and preparation of the graft bed.

CARTILAGE—Eighteen cartilage grafts were placed. Sterile normal saline solution was also used as a reconstituting medium. Fifteen grafts were placed from an intraoral approach. Ten of the intraoral grafts were performed immediately after extraction of the teeth and reduction of the alveolar ridge to prepare a bed for the graft. Five intraoral grafts were placed after complete healing of the soft tissues over the prepared graft bed. Three carti-

lage grafts were placed from an extraoral approach. The surgical technic employed was the same as that described for the intraoral and extraoral grafts (Fig. 1, 2).

■ *Results*

AORTA—Seven grafts (50 per cent) were successful (see table). Clinically the alveolar ridges retained the height and contour which was established by grafting, and the grafts became fixed into the mandible in from four to six weeks. Histologic evidence of complete osteogenesis was noted after 126 days. In one instance trauma from an opposing tooth created a small ulcer which exposed the graft. The trauma was relieved as soon as this condition was noted, and there was complete repair of the soft tissues overlying the graft. The remaining postoperative course was uneventful.

Virtually complete replacement of the aortic tissue by living bone was found on microscopic examination of cross sections of the mandible 126 days after insertion of the graft (Fig. 3, left). Special elastic stain used to prepare this tissue for microscopic study revealed an interlacing of the remaining elastic fibers of the aorta with new bone that was replacing the graft (Fig. 3, right).

BONE—Five bone grafts (30.7 per cent) were successful (table). Clinically

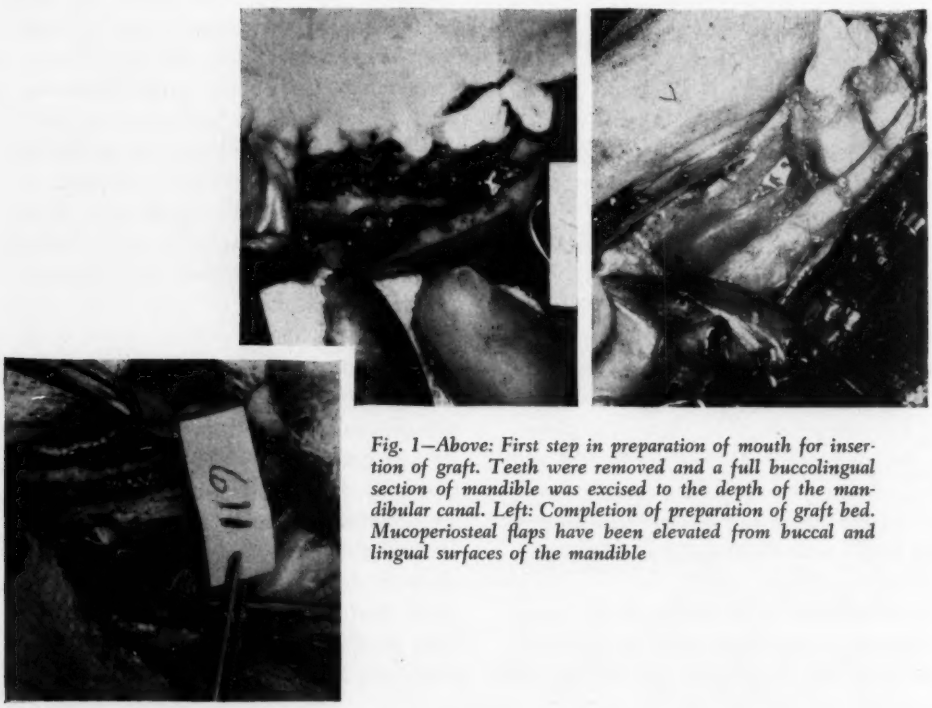


Fig. 1—Above: First step in preparation of mouth for insertion of graft. Teeth were removed and a full buccolingual section of mandible was excised to the depth of the mandibular canal. Left: Completion of preparation of graft bed. Mucoperiosteal flaps have been elevated from buccal and lingual surfaces of the mandible

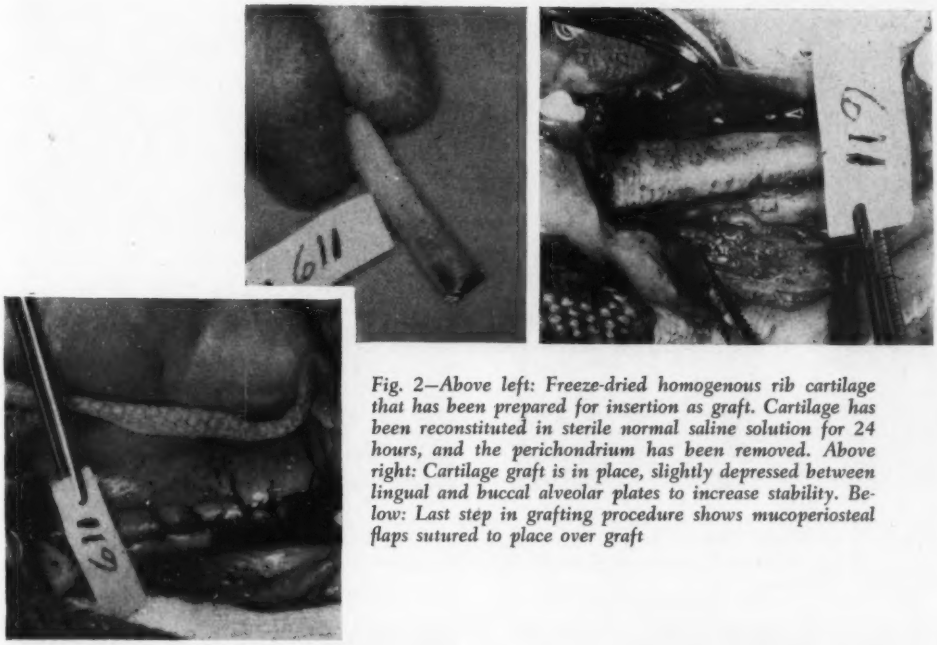


Fig. 2—Above left: Freeze-dried homogenous rib cartilage that has been prepared for insertion as graft. Cartilage has been reconstituted in sterile normal saline solution for 24 hours, and the perichondrium has been removed. Above right: Cartilage graft is in place, slightly depressed between lingual and buccal alveolar plates to increase stability. Below: Last step in grafting procedure shows mucoperiosteal flaps sutured to place over graft

there was complete healing and the grafts became firm in their beds in four to ten weeks. The mandibles retained the form and contour established by grafting. In this group there was also one instance in which the wound opened spontaneously because of excessive tension at the line of incision a few days after the graft was placed. The graft was successfully retained, however, after epithelization occurred and the small area of exposed bone was covered by soft tissue.

Postmortem histologic examination of a cross section of the mandible containing the graft that had been in place for 227 days (Fig. 4) showed that the replacement of dead bone of the graft by viable new bone was nearing completion.

CARTILAGE—Eleven cartilage grafts (60 per cent) were successful (table). Clinically there was complete healing and fixation of the graft to the mandible in from two to six weeks. Histologic examina-

Table

Comparative results

Type of tissue	No. of grafts	Approx. time for fixation of graft	Approx. time for complete osteogenesis	Successful grafts
Aorta	14	28–42 days	126 days	7 (50%)
Bone	13	28–70 days	227 days	5 (30%)
Cartilage	18	28–42 days	126 days	11 (60%)

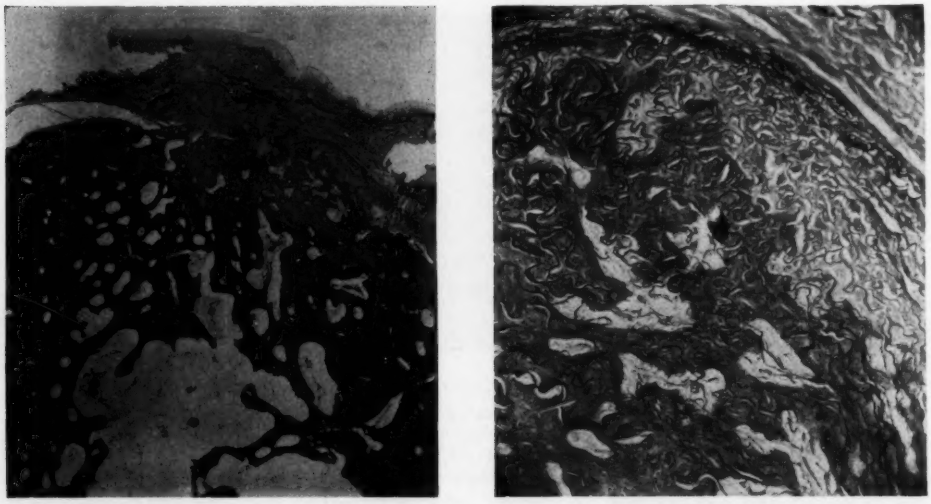


Fig. 3—Aortic graft. Left: Area, 126 days after grafting. Mucosa and fibrous connective tissue overlying graft. Irregular line of demarcation can be noted between new bone and soft tissue. Special elastic stain was used to prepare tissue for microscopic study. Right: New bone is forming throughout region in which elastic fibers still remain

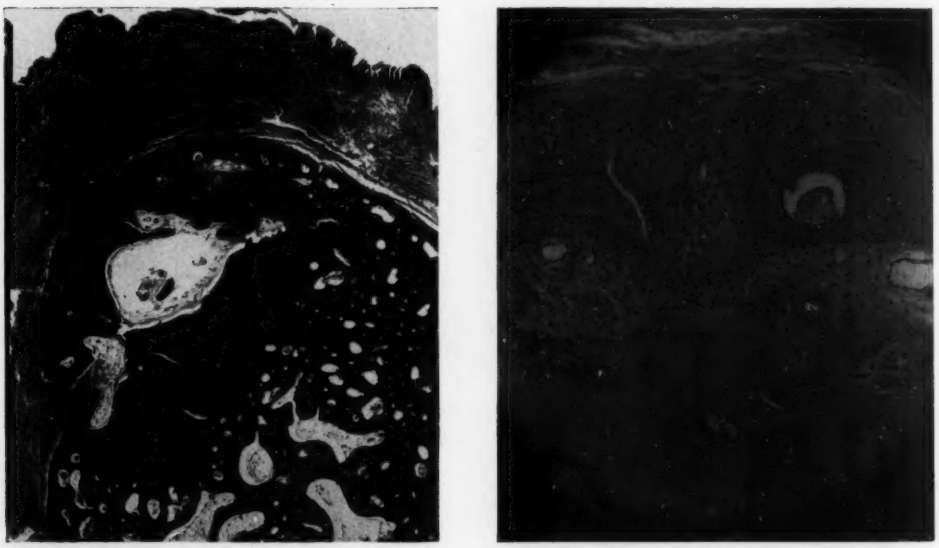


Fig. 4—Bone graft. Left: Cross section of grafted portion of dog's mandible in which a freeze-dried homograft had been inserted 227 days previously. Note that degree of osteogenesis compares favorably with section in aortic graft 126 days after operation. Right: High magnification of new bone formation. In cellular connective tissue, in upper portion of photomicrograph, is new bone. An irregular spicule of nonvital bone is evident in lower portion of illustration; in this spicule there is osteogenesis about the vascular spaces

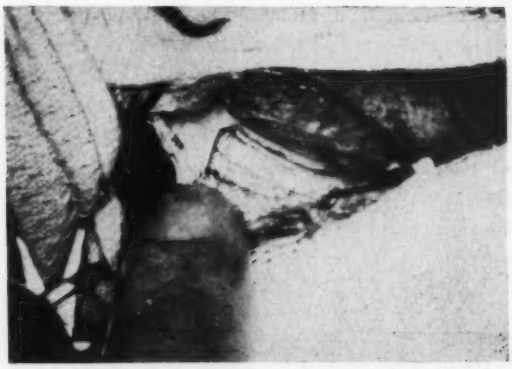


Fig. 5—Cartilage graft. Clinical examination of cartilage graft in place 157 days after operation. A horizontal line of demarcation may be noted between the margin of mandible and cartilage graft. At the time of this examination, graft was indistinguishable from bone. There was clinical evidence of vascularization of surface of graft

tion revealed osteogenic replacement of the grafts in approximately 126 days. In one instance an exploratory operation was done for the purpose of clinical evaluation of the cartilage graft on the one hundred and fifty-seventh postoperative day (Fig. 5). A line of demarcation between the mandible and the graft was noted, but there was a solid union. The graft was indistinguishable from bone. There were multiple small regions where blood vessels communicated between the overlying soft tissue and the graft, indicating that the surface of the graft at least was well vascularized at that time. In this group of 11 successful grafts there were five instances in which there were small ruptures or traumatic ulcerations of the mucoperiosteum that exposed the graft, but that did not result in exfoliation of the graft. As happened in one instance with both aorta and bone grafts, epithelization occurred which covered the exposed cartilage, and the remaining postoperative course was uneventful.

Some of the dogs in which cartilage grafts were placed were sacrificed at periodic intervals, and histologic studies were made in order that the progress of osteogenesis could be evaluated more accurately (Fig. 6-8).

Examinations were made of cross sections of the mandibles through the graft sites at intervals of 49 days, 77 days, 126 days, and 217 days. Vascularization of the cartilage occurred rapidly. Cartilage being replaced by perivascular new bone was clearly evident on histologic examination 49 days after the graft was inserted (Fig. 6). Osteogenesis was complete with the exception of one small island of cartilage which remained at 126 days (Fig. 7). At 217 days complete replacement by a mature type of bone could be noted. The contour of the mandible was retained as restored by grafting (Fig. 8).

■ *Summary of Factors Causing Failures*

A summary of some of the factors which may have resulted in the failures in this study is as follows:

1. Four thicknesses of freeze-dried aorta sutured together approximated the same dimension as the single solid graft of either bone or cartilage. However, the

layers created a greater possibility that dead space would exist after grafting than would be the case with one solid graft with all surfaces surrounded by host tissue. There appeared to be some expansion of the aortic grafts for a few days postoperatively which resulted in excessive tension on the line of suture.

2. Cortical freeze-dried bone is extremely dense and inelastic. These qualities resist the vascularization that is necessary before osteogenesis can occur. This also results in a decreased possibility of spontaneous repair by epithelization if a rupture occurs in the overlying soft tissue. Bone is difficult to fit into the prepared

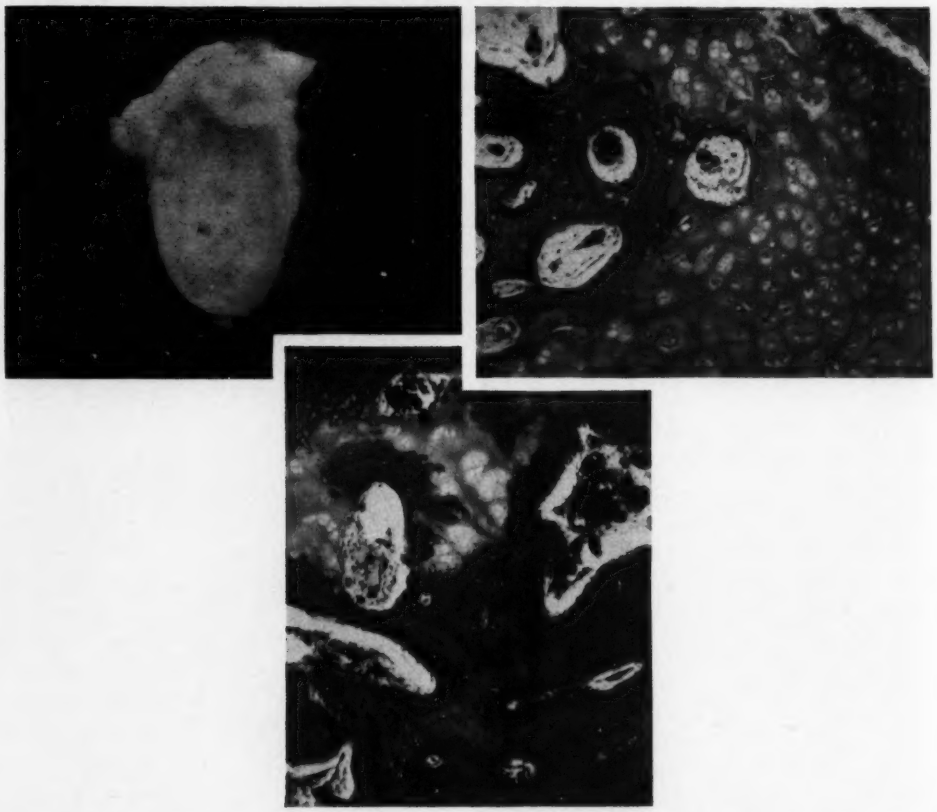


Fig. 6—Cartilage graft. Above left: Cross section of mandible shows gross clinical picture found on examination at 49 days. Graft is still distinguishable, but it is held firmly in its bed which appears to be more vascular than the bone deeper in the jaw. Above right: Cartilage is being replaced by bone. Note new bone which has formed a ring about the blood vessel in the center of the field. Below: Proportion of bone to cartilage has increased at 77 days as compared to histologic findings at 49 days. Several areas of clearly defined perivascular new bone may be noted. Osteoclastic and osteoblastic activity is evident

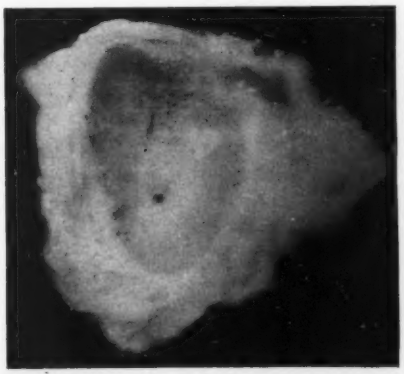
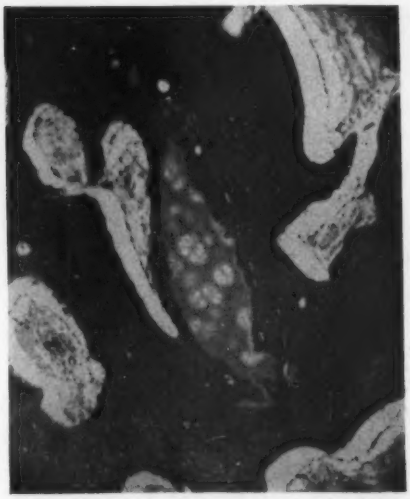


Fig. 7—Cartilage graft. Left: Gross cross section of dog's mandible in which cartilage graft has been in place for 126 days. Grafted portion is more vascular but otherwise presents appearance of normal mandible



Right: Cartilage graft. Only remaining island of cartilage which was found on microscopic examination at 126 days can be seen

graft bed without some dead spaces remaining about the margins. Excessive granulation thus is able to form on the surface of the graft bed, and if the graft is not readily vascularized, pressure from the granulation tissue will result in exfoliation.

3. It is the impression of the authors that the failures with cartilage can be accounted for on the basis of postoperative trauma with the exception of one case. In this instance it was noted on the sixteenth postoperative day that the grafted ridge was decreasing in size. Five days later the ridge assumed the contour and dimension established at the time the graft bed was prepared. There was no evidence of communication of the graft with the mouth. The operative site healed by primary intention, and the postoperative course was entirely uneventful except for the unexplained complete absorption of the graft.

4. In instances in which any one of the three types of grafts was lost after rupture of the overlying mucoperiosteum, it was interesting to note the time elapsed between the operation and the first exposure of a portion of the graft. This time varied from 6 to 15 days, the average time being 10 days. The elapsed time between the first exposure of a portion of the graft and complete exfoliation also was noted. This time varied from 5 to 91 days, the average time being 45 days. During this extended period no effort was made to

stabilize the grafts further. In some instances antibiotic therapy was given; however, this apparently did not alter the course. If a portion of the graft was vascularized prior to exposure in the mouth, osteogenesis occurred in one aspect of the graft while a degeneration of the graft and host tissues was progressing in another.

5. In the early phase of this study several unfavorable postoperative results were to some extent the result of trauma. The dogs attempted to alleviate their oral discomfort by gently chewing their foreleg and paw which resulted in hair-matting under the sutures and the wounds opened, exposing the grafts. Crisp or tough food also was the source of a single traumatic incident to the operative site. The dogs had to learn to chew unilaterally. After these experiences more favorable results were obtained by splinting the left front leg or placing a muzzle on the dog and giving only a liquid diet until the site had healed.

Exfoliation of grafts performed with freeze-dried homogenous tissues is characterized by an unusually mild clinical course. This phenomenon also has been observed when homogenous bone grafts were used to fill defects created by loss of continuity or by cystic and benign tumor defects in the mandibles of human beings.[7]

■ *Clinical Application*

A few short term grafts of freeze-dried homogenous cartilage have been employed in clinical practice. These grafts have not been in place long enough to evaluate them properly. Clinically, however, the postoperative course of these patients has been afebrile and uneventful. It is felt that if resorbed alveolar ridges can be rebuilt by the use of bank tissues applied from an intraoral approach, this procedure will be of value in clinical practice. If an extraoral operation were necessary, the clinical application would be greatly limited. Therefore, all clinical cases have been treated by direct intraoral grafting.

■ *Report of Clinical Case*

A 44 year old white man complained of tenderness to pressure on the edentulous alveolar ridge of the entire mandibular arch. Past history revealed that he had worn full upper and lower dentures for two years.

Physical examination revealed a 44 year old white man whose only complaint was excessive tenderness of the mandibular alveolar ridge. The alveolar ridge was of acceptable vertical dimension but was extremely thin at the crest (Fig. 9, above left). The remainder of the physical examination was noncontributory.

■ *Operation*

A freeze-dried cartilage graft was placed from an intraoral approach under local anesthesia.

An incision was made in the buccal mucosa at a level slightly above the crest of the alveolar ridge extending from the second molar region on the right to the second molar area on the left. The mucosa was elevated from the underlying connective tissue to the base of the sulcus. An incision was then made through the periosteum of the mandible, and the mucoperiosteum was elevated to the crest of the ridge (Fig. 9, above right). Freeze-

Fig. 8—Cartilage graft. Left: Gross cross section of dog's mandible 217 days after insertion of cartilage graft. Note increased density at site of graft

Right: Cartilage graft. No remaining cartilage was found in any of cross sections of mandible removed at 217 days. A mature type of bone had completely replaced the graft and was covered by normal fibrous connective tissue

dried homogenous rib cartilage which had been reconstituted in sterile normal saline solution for 24 hours was shaped with a scalpel to fit the exposed external alveolar plate. The mucoperiosteal flap was placed over the graft (Fig. 9, below left). Because of the increase in size of the arch after grafting, no attempt was made to close the mucosal defect. The margin of the flap was sutured to the deep tissues at the base of the sulcus (Fig. 9, below right). This created a mucosal defect in the cheek and lip from the base of the sulcus superiorly, approximately 12 mm. wide. This defect epithelized uneventfully.

At the time of this report, the graft is firm and the patient is comfortable; dentures have not been replaced over the graft. If progress continues to be satisfactory, dentures will be constructed in the near future.

■ *Summary*

A research project was carried out in which freeze-dried homogenous aorta, bone and cartilage were grafted to the edentulous ridges in a small number of experimental animals. A graft was considered successful when it was retained firmly in its bed and histologic examination revealed that new bone had replaced the graft.

Forty-five grafting procedures were carried out. Twenty-three grafts (50 per cent) were successful. Eleven of 18 (60

per cent) of the cartilage grafts were successful; five of 13 (30.8 per cent) bone grafts were successful; seven of 14 (50 per cent) aortic grafts were successful.

Complete osteogenesis in grafts of cartilage and aorta occurred in approximately 130 days. The microscopic findings showed this to be 100 days less than the time required for replacement by bone when a freeze-dried bone graft was employed. Therefore, cartilage and aorta seem to be superior to bone when osteogenesis only is considered. However, cartilage is preferable to aorta in most instances because a single piece of tissue is more easily managed than multiple layers of tissue. Cartilage which has been reconstituted is pliable and easily cut with a scalpel to fit the bone defect. This ease of handling is an important consideration

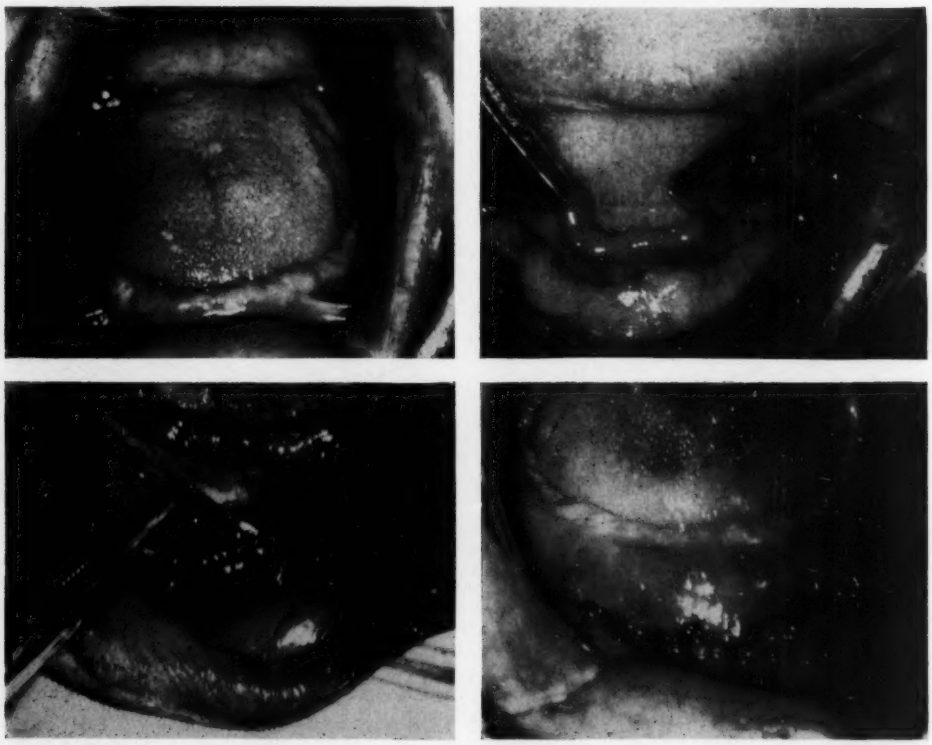


Fig. 9—Above left: Thin alveolar ridge of patient who had worn full upper and lower dentures for two years. He had been unable to wear lower denture comfortably. Above right: Buccal and labial aspect of alveolar ridge is exposed and mucoperiosteum is being reflected superiorly. Below left: Grafted cartilage has been contoured to fit the buccal and labial aspects of alveolar ridge. Below right: Operative site is closed by suturing mucosal flap to denuded tissue at base of sulcus, thus maintaining sufficient depth for denture stability

in clinical practice. The impression is gained that bone grafting in clinical practice could be accomplished, in selected cases, with freeze-dried homogenous cartilage and aorta in an elapsed time comparable with that when fresh autogenous bone is used. Most of the postoperative complications in this study can be accounted for by difficulty in management of the experimental animals. These dogs gently chewed their left forelegs and paws, which caused opening of the wounds in some instances before primary healing was complete.

Urist[8,9] states that the exact mechanism of osteogenesis has not been discovered. He also suggests that the host tissues are more important in the process of osteogenesis than the tissues of the graft. The results of this limited study support his findings.

This work has not proved conclusively that intraoral alveolar grafts are practical in the practice of dentistry. The results were sufficiently encouraging, however, so that alveolar ridge grafts are being evaluated clinically.

■ *Conclusions*

1. Alveolar ridge height and contour can be re-established in dogs by intraoral grafts.

2. Osteogenesis occurs and grafts of freeze-dried homogenous aorta, bone and cartilage are replaced by living bone in dogs.

3. Freeze-dried homogenous cartilage is a more satisfactory tissue for grafting alveolar ridges in dogs than is freeze-dried homogenous aorta or bone.

4. Complete osteogenesis after a grafting procedure with aorta or cartilage that has been prepared by freeze-drying closely approximates the healing time of an autogenous bone graft.

5. The results of this study are sufficiently encouraging to warrant the continued clinical evaluation of alveolar ridge grafts in the practice of dentistry.—*20600 Lake Chabot Road.*

8. Urist, Marshall R. Physiologic basis of bone-graft surgery, with special reference to the theory of induction. Reprint from Clinical Orthopedics, No. 1. Philadelphia, J. B. Lippincott Co., 1953.

9. Urist, R., and McLean, C. Osteogenic potency and new-bone formation by induction in transplants to anterior chamber of eye. J. Bone & Joint Surg. 34-A:443 April 1952.

■ MAN'S LIMITED KNOWLEDGE

It is a curious fact that, having minds tending to the infinite, with imaginations unlimited by time and space, the limits of our exact knowledge are very small indeed. *Henry A. Rowland.*

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Periadenitis mucosa necrotica recurrens: *report of case*

■ *Charles C. Alling, D.D.S., M.S., El Paso, Texas*

The disease entity of periadenitis mucosa necrotica recurrens is characterized by the formation of firm plaques or nodules which ulcerate and resolve to scar formation in constantly recurring cycles. These nodules are located on the mucous membranes of the mouth and pharynx.

The literature concerning this disease is sparse and confusing. Prinz and Greenbaum[1] have given credit to Mikulicz for describing the disease in 1888. Ormsby and Montgomery[2] stress the contributions of Loblowitz in 1910 and Sutton in 1920.

The various synonyms include Mikulicz's aphthae, chronic intermittent recurrent aphthae, recurrent canker sores, ulcus neuroticum mucosae oris and chronic aphthae. The name periadenitis mucosa necrotica recurrens best describes this rare but definite entity, as the disease begins in the vicinity of mucosal glands, produces a necrotic membrane and is recurrent.

The following case illustrates attendant diagnostic features and points of differential diagnosis.

The patient, a 28 year old white woman, was referred to the oral surgery service, University Hospital, Ann Arbor, Mich., for evaluation of "canker sores" in her mouth.

HISTORY—The onset of the disease was about 20 years previously at the age of eight or nine years. There was constant unremitting course of lesions over two decades with the patient never being free from attack except during her two pregnancies. The lesions appeared singly or in groups. The first manifestations were typically a firm plaque or nodule from which the center sloughed, yielding a painful, necrotic ulcer. The ulcers would last from four to six weeks and resolve, leaving a scar.

Previous treatment was manifold and varied; it consisted of antibiotics administered locally and systemically, sulfanilamides, caustics applied to the lesions, solutions of neoarsphenamine, cathartics, tonics, vitamin and other nutritional supplements, fasting, estrogen compounds, elimination diets and vaccination with variolous vaccine. These treatments failed to afford even temporary relief. The patient's dentist had tried various kinds of restorative materials with no results.

The history revealed the patient to have suffered dyspepsia for a period of years for which she used various professionally prescribed and commercial sedative preparations. She had been described as having a mild fixation neurosis.

The patient was a multipara and had experienced relief from her oral lesions during her two pregnancies. The lesions disappeared shortly after the pregnancy was first suspected,

Major, Dental Corps, U.S. Army, William Beaumont Army Hospital.

1. Prinz, Hermann, and Greenbaum, S. S. Diseases of the mouth and their treatment. Philadelphia, Lea & Febiger, 1939.

2. Ormsby, O. S., and Montgomery, H. Diseases of the skin, ed. 7. Philadelphia, Lea & Febiger, 1948.

that is, four to six weeks after conception, and reappeared about a week after delivery.

Although the lesions were with her at all times, there were periods of unexplained comparative relief when only one or two lesions were present. During these periods the patient ate heavily in order to weather better the next episode of multiple lesions when eating would again be difficult. By this method, she retained her normal weight.

EXAMINATION—The patient was well developed and well nourished. She had no abnormal facies. Intraoral examination revealed a normal complement of teeth with no carious lesions and with amalgam, gold inlay and silicate cement restorations. The mucous membrane on the cheeks, covering the tongue, lining the pharynx and on the mucoperiosteum over the alveolar ridges was marked by numerous scars.

There were four ulcers in the mouth on the first examination in July 1952. They were irregular in outline, with discrete margins and fibrinous centers, and varied in size from 1 cm. to 3 cm. in diameter. On subsequent examinations over a period of five months before therapy was begun in December 1952, a variety of locations and shapes of lesions was noted, but the patient was never completely free of lesions.

The impression gained from the history and examination was that the patient had periadenitis mucosa necrotica recurrens.

COURSE—In consultation with Donald Kerr, a program was established to explore various treatment approaches. The key to the treatment was the factor of freedom from the lesions during the pregnancies. The first problem was to determine the pattern of onset in relation to the menstrual cycle. The patient faithfully recorded the menstrual cycle and the appearance of the lesions over a four month period; no correlation or cyclic pattern could be established.

The possibility that high estrogen levels eliminated the lesions had been previously explored by the patient's family physician with no relief, so this aspect was deferred.

In a study of relief of rheumatoid arthritis pains during pregnancy, it was noted that cortical steroids gave relief to symptoms of rheumatoid arthritis. It was reasoned, therefore, that an ACTH-like substance elaborated by the placenta could have relieved the patient of the oral lesions during pregnancy.

With the guidance of the department of endocrinology and metabolism at the University Hospital, Ann Arbor, Mich., in December 1952, a test dose of 20 mg. of ACTH in 1,000 cc. of 5 per cent glucose was administered intravenously over an eight hour period. There were four lesions at that time. For the following two weeks, 100 mg. of cortisone was taken orally on the following regime: 50 mg. at breakfast, 25 mg. at 3 p.m. and 25 mg. at bedtime. On the third day of cortisone therapy, a rapid subsidence of the four lesions was noted, and no new ones were appearing. The affected regions of the mouth before and after therapy are shown in Figures 1 and 2.

The patient had freedom from the lesions until December 22, when a nonpainful lesion appeared shortly after she ate chocolate. A cortisone withdrawal program was established, beginning January 1, 1953. Fifty milligrams were given daily for one week, then 25 mg. daily for one week, and finally 12.5 mg. daily at bedtime for an indefinite period.

The patient has remained on an irregular intermittent schedule of 12.5 mg. cortisone daily to this writing in January 1954. Lesions have occurred, but they are not as numerous, painful, extensive, nor long-lasting as the lesions which appeared before the cortisone therapy. The lesions are intermittent, appearing in an irregular cycle of decreasing frequency with periods of relief between attacks. The patient takes 12.5 mg. cortisone daily in response to the occurrence of the lesions. The last attack was in October 1953. The patient is no longer inconvenienced by the occurrence of the lesions. She is not pregnant and has continued the use of the sedatives for the dyspepsia.

The long-standing, unremitting character of the disease was alleviated in a matter of hours by the ACTH-cortisone therapy. The schedule of 12.5 mg. of cortisone taken on an irregular schedule in decreasing frequency in response to the appearance of the oral lesions

Fig. 1—Left: Periadenitis mucosa necrotica recurrens lesion of lip one day before therapy. Note irregularity of labial mucous membrane denoting scars of resolved lesions. Right: Four days after beginning of therapy. Note subsidence of lesion

Fig. 2—Lesions of right lateral tongue one day before beginning therapy and five days after beginning therapy

is not believed to have a therapeutic, medicinal action, and has been continued for psychological reasons.

COMMENT—The etiology of periadenitis mucosa necrotica recurrens is unknown. Associations to neuroses, to enteric and dyspeptic disturbances, to menstrual cycles, to foods and other factors have been described.

The main differential diagnosis should be made between periadenitis mucosa necrotica recurrens and herpetic stomatitis. Differential points may be seen in that periadenitis mucosa necrotica recurrens begins in plaques or nodules, forms an ulcer that lasts for weeks and forms scars. Another differential point is that the patient has had no freedom from the disease for years. The herpetic stomatitis lesions begin as vesicles, form ulcers that last for a matter of days, resolve without leaving scars, and the attacks are spasmodic with periods of freedom between episodes.

Osteomas of the oral cavity: *report of cases*

■ *John C. Versnel, D.D.S., M.S., St. Louis*

An osteoma is a benign bone tumor,[1] possibly of varied and certainly of disputed origin. This tumor may be observed in two forms: the compact or marble-like exostosis and the spongy variety.[2] It is believed, by some, that the latter is the immature form of the hard tumor. Today, the various theories of the cause of osteomas include trauma, new growth from an embryonal periosteal rest, or an infection or a suppurative condition in the region.[3] It is possible that all of these factors play a role, either jointly or individually, in the formation of this new bony growth.

In these cases a history of infection of long standing was reported to be in the region prior to the formation of the new growth.

The first case is reported because of the rarity of the position of the osteoma and the size of the tumor mass, as well as the gratifying results from an intraoral surgical approach.

CASE 1—A white girl 16 years of age was referred to the oral surgery clinic at Firmin Desloge Hospital by the ear-nose-throat clinic with the diagnosis of a hard tumor mass firmly attached to the lateral aspect of the body of the mandible on the right side (Fig. 1).

On February 10, 1949, an oral examination revealed that the dentition was in fair condition with the exception of the mandibular right first molar, of which only the roots remained. There was a periapical involvement of such nature as to indicate an infection of long standing. The remaining oral structures appeared to be normal.

There was a hard rounded mass, 3 by 3 by 3 cm., on the lateral aspect of the mandible in the second and third molar region. This mass appeared to be firmly attached to the mandible. Roentgenographic examination re-

1. Ballenger, W. L. Diseases of the ear-nose-throat. Philadelphia, Lea & Febiger, 1943, p. 477.
2. Thoma, K. H. Oral pathology, ed. 3. St. Louis. The C. V. Mosby Co., 1950, p. 970.
3. Vadala, A. J., and Somers, K. Osteoma of frontal sinus. Arch. Otolaryng. 50:618 Nov. 1949.

Fig. 1—Case 1. Preoperative views showing malformation caused by peripheral compact osteoma

vealed a round, smooth, dense bony mass attached to the body of the mandible by a pedunculated base of 2 cm. (Fig. 2). This mass appeared to arise directly from the cortex of the mandible.

The patient was hospitalized on February 24 with the recommendation of extraction of the mandibular right first molar roots, prophylaxis of the oral cavity and excision of the tumor mass.

The patient was in no apparent distress and gave a history of a slow growing mass on the lateral aspect of the mandible of about one and one-half years' duration. The growth was painless and had never ulcerated. The past history was noncontributory.

A physical examination failed to reveal any abnormalities with the exception of the evident growth. Laboratory examination showed the following: urinalysis, normal; white blood cell count, 9,500; red blood cell count, 5,000,000; hemoglobin, 13 Gm. per hundred cubic centimeters; differential white blood cell count, normal; bleeding time, two minutes; clotting time, three and one-half minutes and the Kahn test, negative.

The patient was premedicated with penicillin 24 hours before operative procedure. On February 28, one-half hour before surgical procedure, the patient received 0.4 mg. (1/150 grain) atropine sulfate and 10 mg. (1/6 grain) morphine sulfate. A general intratracheal anesthetic of ether, nitrous oxide and oxygen was administered for the operation.

An intraoral incision was made along the right mandibular mucobuccal fold and the external oblique ridge of the ascending ramus of the mandible. The mucosa and periosteum were reflected from the mandible and the tumor mass. With a chisel, the mass was removed at its pedunculated base, intact, from the cortical plate. The region was smoothed with a bone file. An iodoform drain was placed in the wound, and interrupted sutures were used to close the incision. A pressure dressing was applied to the right side of the face.

On March 2 and 3, a portion of the iodoform gauze was removed; the remainder was removed on March 4. Penicillin therapy was continued for 96 hours postoperatively. The patient had an uneventful recovery and was discharged from the hospital on March 10.

The pathological report stated: "The tumor mass consists of a dense compact bone, well differentiated with small, narrow spaces which appeared fibrotic. Diagnosis: osteoma."

Postoperative examinations from April 17, 1949, to June 29, 1950, showed that the wound had healed satisfactorily.

Postoperative roentgenographic examination of the mandible, with detailed examination of the body of the mandible on the right side, revealed the mandibular right first molar to have been extracted and the large tumor mass removed. There was a very slight irregularity of the cortex at the site of the operative procedure.

Clinical and roentgenographic examinations on January 25, 1951, failed to reveal any recurrence of the tumor mass.

CASE 2—The second case also reveals a history of infection in the region of the new growth just previous to its formation. Microscopic examination of the tumor specimen revealed the presence of chronic inflammatory cells at the time that the mass was growing.

On May 29, 1950, a 67 year old woman was referred to the oral surgery clinic of Firmin Desloge Hospital by her dentist for the removal of a tumor mass in the right maxilla. The patient said that she had had this mass on the right maxilla for the last 25 years or at least a short time after the teeth were removed from this region. The patient stated that there had been "a great deal of infection" around the tooth at the time of extraction. Apparently, there also had been a discharge from the region for some time after the extraction. She had noticed that the mass had grown slowly in the past two years. The patient was in no acute distress, and the lesion was asymptomatic.

Clinical examination revealed an edentulous maxilla and mandible. There was a hard mass measuring 5.0 by 3.5 cm. on the ridge of the right maxilla. Other clinical oral findings appeared to be normal.

Roentgenographic examination of the maxilla revealed a large irregular tumor mass in the maxilla on the right side which appeared to involve the alveolar ridge and to extend in all directions (Fig. 3). The tumor mass ap-

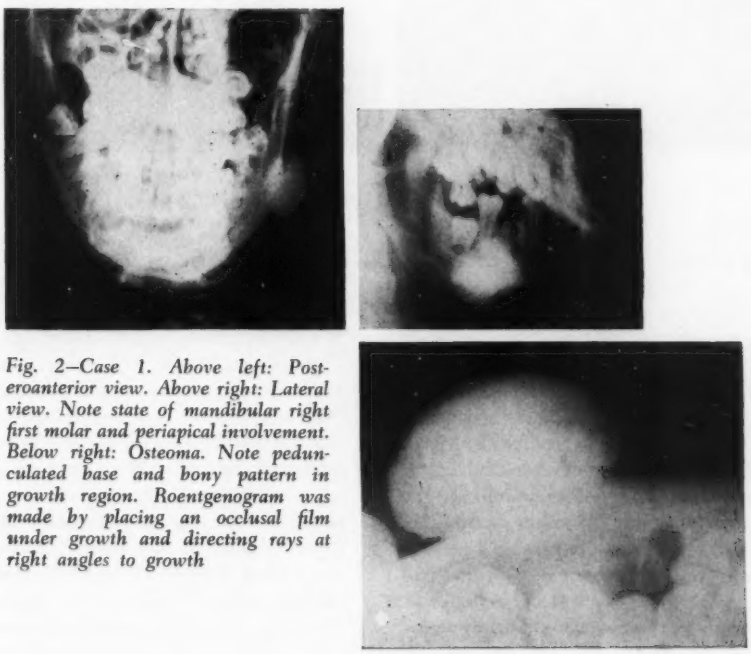

Fig. 2—Case 1. Above left: Posteroanterior view. Above right: Lateral view. Note state of mandibular right first molar and periapical involvement. Below right: Osteoma. Note pedunculated base and bony pattern in growth region. Roentgenogram was made by placing an occlusal film under growth and directing rays at right angles to growth

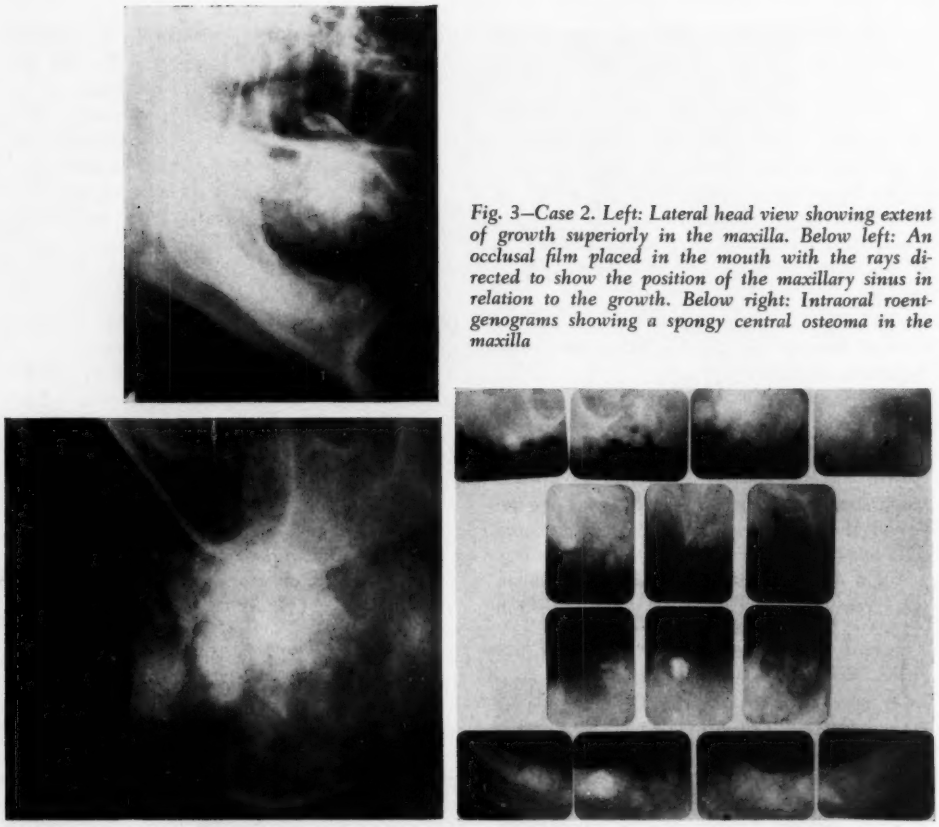

Fig. 3—Case 2. Left: Lateral head view showing extent of growth superiorly in the maxilla. Below left: An occlusal film placed in the mouth with the rays directed to show the position of the maxillary sinus in relation to the growth. Below right: Intraoral roentgenograms showing a spongy central osteoma in the maxilla

peared to be sharply outlined and to contain several small irregular regions of increased density. The mass extended superiorly to involve the floor of the right maxillary sinus.

A provisional diagnosis of an osteoma was made, and the patient was scheduled for hospitalization and excision of the tumor mass.

On June 6, the patient entered St. Mary's Infirmary hospital. A complete physical examination showed no new pertinent information, and the routine examination results were within normal limits. The urinalysis was normal. The white blood cell count was 4,800; the red blood cell count was 4,470,000; the hemoglobin was 12.7 Gm. per hundred cubic centimeters; the bleeding time was one minute; the clotting time was four minutes and the Kahn test was negative.

Preoperative orders were phenobarbital (Luminal) 0.2 Gm. (3 grains) at bedtime; penicillin G procaine in oil (Duracillin, 300,000 units) 1 cc. daily; morphine sulfate, 15 mg. (¼ grain); atropine sulfate 0.4 mg. (1/150 grain) one-half hour before surgical procedure.

On June 7, the patient was taken to surgery, and the tumor mass was removed under local anesthesia. The procedure consisted of an incision along the alveolar crest from the midline of the maxilla to the right maxillary tuberosity. The tissue was retracted, and with a

chisel and rongeur forceps, the mass was removed intact. The area was curetted, absorbable gelatin sponge (Gelfoam) was placed in the defect, and the wound was closed by means of interrupted silk sutures.

The gross examination revealed a tumor mass of the right maxilla about 4.0 by 4.0 by 5.0 cm. The bone was soft and "cakelike" in consistency. There was a distinct hard core in the center of the mass. No definite capsule could be determined as outlining the tumor.

Postoperative orders consisted of penicillin G procaine in oil (Duracillin), 1 cc. daily; codeine, 60 mg. (1 grain) for pain every four hours if necessary; saline mouth rinse and ice packs to the right side of the face.

On the first postoperative day the temperature rose to 99.2° F. and then returned to normal. There was very slight swelling to the right side of the face.

The microscopic examination revealed a calcified dense bone with clumps of finely granular material, probably microorganisms. In other regions chronic inflammatory cells were seen. Diagnosis was osteoma with chronic inflammation.

The patient was discharged from the hospital on the third postoperative day, with an uneventful recovery.

On June 10 and June 12 the patient was seen in the outpatient oral surgery clinic of Firmin Desloge Hospital, and on the latter date the sutures were removed. The patient experienced little discomfort and had an uneventful recovery.

Subsequent follow-up examinations at six month and one year intervals failed to reveal the return of the growth.

SUMMARY—Two instances of an osteoma in the oral cavity are reported. One of the growths was compact and the other, spongy. In each instance the history of the patient tends to substantiate that one of the causes of an osteoma is a prior chronic infection. The tumor growths had been preceded by infection, and inflammatory cells were demonstrated in the tumor that was reportedly growing at the time of surgical intervention. The latter feature would also lead one to believe that the spongy osteoma is an immature form of the compact osteoma.—*205 University Club Building.*

A sialolith within the submaxillary duct and gland: *report of case*

■ *Newton E. Allen, D.D.S., Selma, Ala.*

On October 12, 1953, a 49 year old negro man was referred by his physician for the diagnosis and management of pain and swelling in the region of the left submaxillary gland. It was learned from the physician that the patient had submitted to a physical examination and was in excellent health other than the condition mentioned previously.

HISTORY—Similar attacks had occurred repeatedly over a period of 20 years, and the patient stated that the floor of his mouth had been probed or lanced "over a hundred times" for relief. Several teeth had been removed during this period. Penicillin had been administered by his physician for two days prior to the current examination.

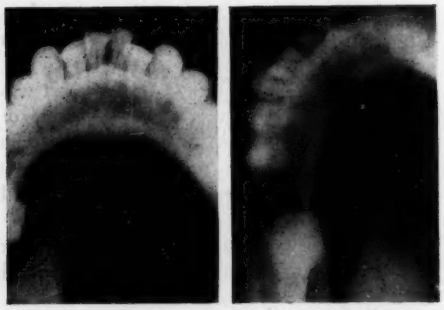

Fig. 1—Left: Anterior part of salivary calculus. Right: Modified occlusal view made by directing ray from beneath left angle of mandible

CLINICAL EXAMINATION—The oral examination revealed a fairly good state of hygiene and repair. A moderate amount of salivary calculus was present on the teeth. Several molars were missing. The tissues of the floor of the mouth on the left side were swollen and inflamed. Bimanual palpation of the region gave the impression that a hard mass occupied the space between the floor of the mouth and the extraoral swelling. The patient's temperature was 100.2° F.

ROENTGENOGRAPHIC EXAMINATION — A radiopaque structure resembling a large salivary duct calculus could be seen in the posterior part of occlusal roentgenograms. It was situated to the left of the median line with the anterior tip extending to a point opposite the first molar region (Fig. 1). A lateral jaw roentgenogram was made by directing the central ray upward and forward from a point well below the inferior border of the mandible on the opposite side (Fig. 2, left). This angle, unfortunately, produced an image of the calculus on the film in a position anterior and superior to its true position in relation to the mandible. This was not realized at the time or a true lateral or profile roentgenogram would have been taken.

TREATMENT—Premedication consisted of the oral administration of 0.1 Gm. (1½ grains) of pentobarbital sodium and the intramuscular injection of 600,000 units of procaine penicillin. Local anesthesia was obtained by blocking the inferior dental and lingual nerves and by infiltrating the operative site with a 2 per cent anesthetic solution with epinephrine 1:50,000.

An incision was made in the region of the floor of the mouth overlying the mass, and by a combination of blunt and sharp dissection a grayish white capsule containing the calculus was exposed. This structure was much deeper than had been indicated by the roentgenogram. With the aid of the assistant, who exerted pressure in a superior direction from beneath the mandible, the capsule was incised and a portion of the calculus was exposed. The tip was grasped with a curved hemostatic forcep and was elevated with a rotary motion until it

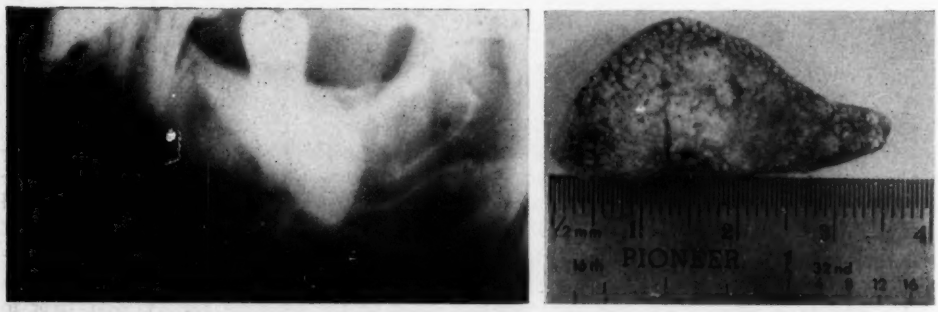

Fig. 2—Left: Image of calculus superimposed on mandible. Right: Median surface of sialolith

Fig. 3—Postoperative view

was delivered. The large space created by the removal of the calculus was irrigated with a sterile saline solution, and a careful inspection of the region was made. Apparently, the bulbous part of the sialolith had rested within the submaxillary gland, and the narrow, constricted part in Wharton's duct. A probe, which was inserted into the caruncula salivaris, passed through the duct into the defect formerly occupied by the stone. In spite of this, it was decided that a more patent flow of saliva could be ensured by suturing the edges of the capsule to the margins of the incision in the oral mucosa. This was accomplished with difficulty because of the inelasticity of the capsule. Soluble no. 000 sutures were used, and iodoform gauze was inserted loosely into the newly created duct orifice.

The sialolith (Fig. 2, right) measured 3.5 by 1.6 cm. Examination of the postoperative roentgenogram revealed no evidence of additional calculi in the region (Fig. 3).

The patient was permitted to go home immediately after the operation and was instructed to return 48 hours later for postoperative care. He agreed to contact his physician for penicillin on the intervening day.

COURSE—On October 14, very little swelling remained. The patient stated that he was completely comfortable for the first time in 20 years. The gauze packing was removed, and 600,000 units of procaine penicillin were given intramuscularly. Five days later the wound apparently had healed and all swelling had disappeared. The patient was last seen on October 27, at which time he was dismissed.

A letter, received from the patient February 6, 1954, stated that no further trouble had been experienced.—*DuBose Building.*

■ CURIOSITY

Curiosity is one of the most permanent and certain characteristics of a vigorous intellect. *Samuel Johnson.*

Surgical removal of bullet from mandibular notch (Korean victim): *report of case*

■ *Stephen P. Mallett, D.M.D., Boston, and Joseph H. Scanlon, Jr., D.M.D.,* Norco, Calif.*

It is frequently difficult to decide whether an extraoral or an intraoral approach is best suited for the removal of a bullet lodged in the sigmoid notch. The case to be described illustrates such a problem.

REPORT OF CASE—The patient gave the history of sustaining a bullet wound on March 3, 1951, while in combat in Korea. The bullet entered the right frontal bone, passing downward to the left, obliquely through the left orbit, lodging in the region of the left zygoma. Several days later at Taegu he was operated on and was then transferred to the Tokyo General Hospital, where a cranial procedure was carried out. He was then transferred to a local government hospital. On admission, April 1, his chief complaints were blindness in the left eye, proptosis of the left eye, a right temporal defect of the skull, inability to walk rapidly and difficulty in opening his mouth adequately.

EXAMINATION AND PHYSICAL FINDINGS—Physical examination on entrance to the hospital revealed a well developed, well nourished 20 year old white man, in no acute distress. Neurological examination revealed a circular pulsating depression in the right frontal area measuring approximately 5 cm. in diameter (Fig. 1). The patient stated that he was totally blind in the left eye except for bright flashes of light which he perceived. Objectively, the left eye showed considerable proptosis of the entire eyeball. The lid was discolored and indurated. The left eye was clear.

The patient showed a subjective loss of sense of smell in both nostrils. The movements of the right eye were normal but movements of the left eye showed the eye to be normally held in a downward position. The eye could be moved medially and superiorly but no lateral motion was discernible. There was considerable malocclusion of the jaws. Sensation of taste was reduced. The patient's gait was slow with his eyes open or closed; there was no evidence of paralysis or spasticity in any extremity or muscle group.

Roentgenographic examination of the skull on April 5 showed a large defect in the right frontal area, postsurgical, with some air in the brain tissue in that region. The defect was rounded and had the appearance of capsulated air in a cyst. There was a large metal fragment in the shape of a bullet lying in the lateral space area behind the defect in the zygoma at its articulation with the temporal bone, near the mandibular notch (Fig. 2).

Examination by the ophthalmologist showed the left eye to be depressed with considerable ptosis of the lid. The left eye was deviated medially and inferiorly. There was a scar in the lower cornea, but this did not appear to be through the whole substance of the cornea. The anterior chamber and lens were clear. The vitreous showed many large opacities, and the posterior section of the eye was completely disorganized, the only retina present being a small part in the upper temporal region. In some areas the choroid was absent and only the sclera could be seen.

Examination by the ear, nose and throat specialist showed the hearing to be normal in both ears. An audiometer test indicated there were no disturbances in vestibular function.

*U.S. Navy Dental Corps.

LABORATORY EXAMINATION—Routine blood and urine tests were not unusual. Cultures and bacterial sensitivity tests of a small draining wound of the right parietal region showed hemolytic *Staphylococcus albus* and *Staphylococcus aureus* which were sensitive to penicillin and streptomycin, chloramphenicol and sulfonamides.

TREATMENT AND COURSE—It was the opinion of the neurosurgical staff that the patient should wait for definitive surgery. He was therefore transferred to the convalescent ward for rest, therapeutic treatment and improved nutrition.

While under the care of the neurological service, the patient was observed to exhibit some evidence of frontal lobe damage. A consultation between the dental service and the neurological service resulted in a plan for repairing the skull defect and removing the missile from the left cheek.

On November 27, 1951, the region was explored under local anesthesia through an in-

Fig. 1—Showing patient's limited ability to open mouth because of bullet which has injured attachment of temporal muscle near coronoid process

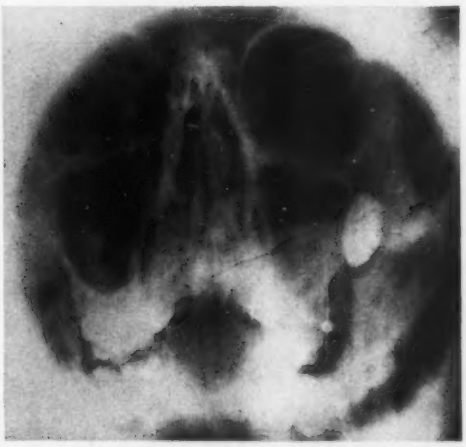

Fig. 2—Left: Lateral view showing bullet near coronoid process. Right: Postero-anterior view showing bullet near mandibular notch

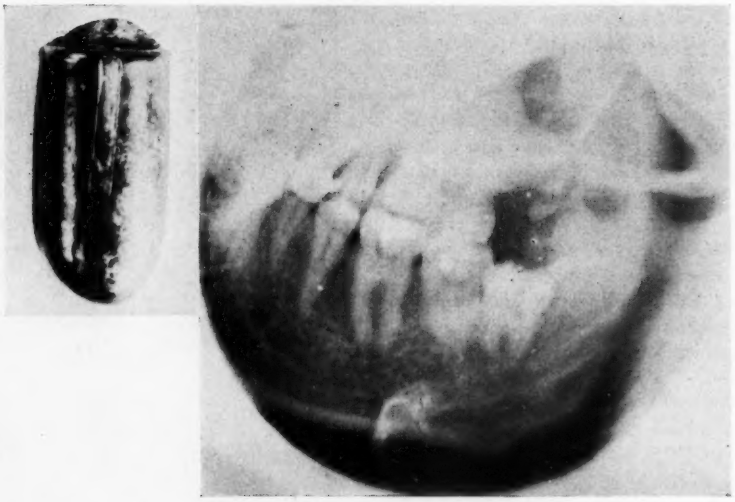

Fig. 3—Left: Bullet. Right: Lateral jaw view showing that bullet and coronoid process have been removed

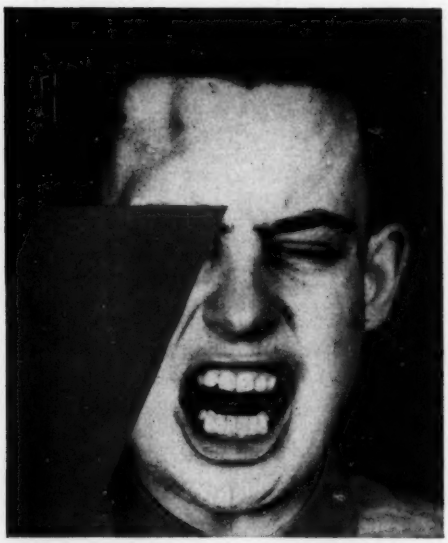

Fig. 4—Frontal view demonstrating amount that patient was able to open his mouth after removal of bullet

traoral approach. An incision was made extending from the maxillary cuspid to the tuberosity area, and the mucoperiosteal flap was reflected allowing suitable access to the superior portion of the ramus of the mandible. Reflection of the masseter and external pterygoid muscles permitted an opening for inspection of the mandibular notch region.

The bullet could not be seen but further retraction of the tissue, including the temporal muscle attachment on the coronoid process, permitted contact with the bullet which was lying on the inner aspect of the mandibular notch, nearer the coronoid process than the condyloid process, with the flat base of the bullet resting in the mandibular notch.

The bullet seemed to be attached firmly to the surrounding soft tissue, which was reddish blue. As it was impossible to free and remove the bullet with the retraction established, a bibevel drill was used to make four holes horizontally in the coronoid process at the level of the mandibular notch and, with chisel and rongeur forceps, the coronoid process was fractured.

The attached tissues were dissected away and the coronoid process removed. The bullet then was easily located and was freed and removed without difficulty with a broken-back type periosteotome (Fig. 3).

The wound was closed with interrupted dermal no. 00 sutures. The patient received adequate penicillin therapy before and after the surgical procedures, with postoperative sedation, cold applications and general supportive care.

The patient was seen daily, and adequate penicillin therapy maintained. Convalescence was uneventful and gratifying.

On November 30, the patient was able to open his mouth approximately 1 cm., and by December 19 he could open it 4 cm. (Fig. 4). He was last seen on April 8, 1952, at which time he could open his mouth 3 cm., having lost 1 cm. when a tantalum plate was placed in the skull defect. He was instructed to resume finger and thumb exercises as an aid in the maintenance of a good functioning masticatory mechanism.

COMMENT—Although fragmented shrapnel may be difficult to find, a whole bullet does not present much difficulty if it is located near lower labial or lingual surfaces of the ascending ramus. When it is located in the coronoid region, as in this instance, an intraoral surgical approach is the one of choice, since it avoids the possibility of traumatizing branches of the facial nerve, with consequent paresis, in addition to facial scarring which would be inevitable if an extraoral dissection were done.—358 *Commonwealth Avenue.*

Pachyderma oralis: *report of case*

■ *Roy C. Kinney,* D.D.S., Seattle, and Randall S. Derifield,† M.D., Saginaw, Mich.*

A few reports have appeared in the literature concerning a congenital white spongy appearance of the mucosa which is often familial and does not become malignant. Most of these reports have been published in journals of dermatology. In 1935, Cannon[1] used the term "white sponge nevus of the mucosa" to apply to this condition. In the cases reported by him, several members of the same family were involved, and similar changes were present on the rectal and vaginal mucosa. Ledy and Shirazy[2] used the term "congenital leukokeratosis of the oral mucosa." Lynch[3] called the condition "leukokeratosis oris." These terms, however, erroneously imply that the condition is limited to the oral mucosa. Gandy,[4] in reporting a case recently, used the term "nevus spongiosus albus mucosae."

As suggested by the variety of titles used in the afore-mentioned reports, a considerable difference of opinion seems to be present regarding this condition. The case reported herein may prove helpful when this rare abnormality is encountered.

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†Chief of medicine, Veterans Administration Hospital, Saginaw, Mich.

1. Cannon, A. B. White sponge nevus of the mucosa (naevus spongiosus albus mucosae). Arch. Dermat. & Syph. 31:365 March 1935.

2. Ledy, J. B., and Shirazy, E. Congenital leukokeratosis mucosa oris. New Internat. Clinics 4:38 Dec. 1941.

3. Lynch, F. W. Leukokeratosis oris. A.M.A. Arch. Dermat. & Syph. 63:145 Jan. 1951.

4. Gandy, D. T. Nevus spongiosus albus mucosae. Texas J. Med. 48:145 March 1952.

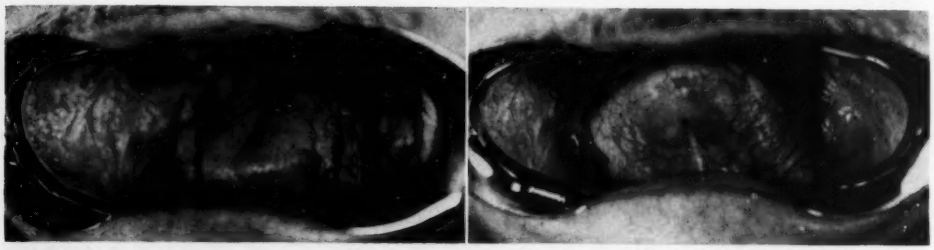

Fig. 1—Left: Hyperkeratosis extending onto palatal area. Right: Hyperkeratosis extending to lateral borders of tongue

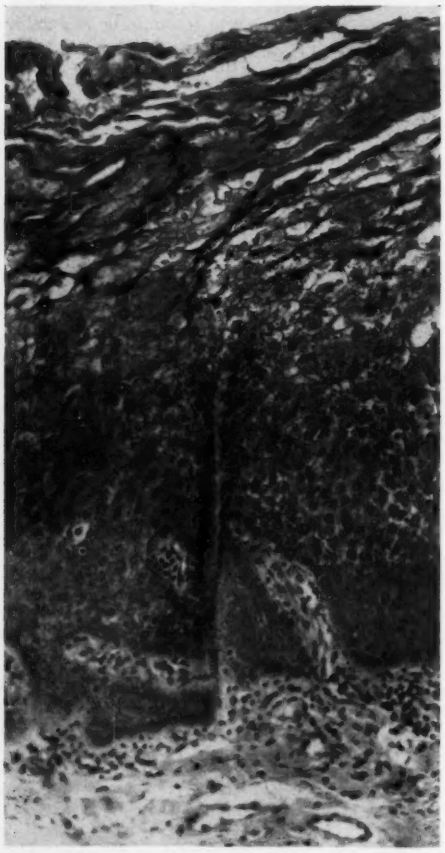

Fig. 2—High-power photomicrograph of lesion from buccal mucosa

REPORT OF CASE—A man, 42 years old, came to the hospital with symptoms of myxedema that had been present for the past six months. This diagnosis was supported by a low basal metabolic rate and an elevated blood cholesterol. The patient also complained of asthma that had been present for many years. He had smoked one package of cigarettes each day for many years. He described his use of alcoholic beverages as moderate.

Physical examination disclosed, in addition to the myxedema and asthma, a most unusual and extensive change in his oral mucosa. These membranes appeared to be thickened, pearly white in color and furrowed with deep crypts and crevices. The change involved the mucosa of most of the inner aspect of the cheeks (Fig. 1, left), portions of the hard and soft palate, the ventral, lateral, and part of the dorsal surface of the tongue (Fig. 1, right), the floor of the mouth, and the alveolar processes. Scrapings from the involved regions were negative for yeast. Other mucous membranes of the body were examined and appeared normal. The patient volunteered the information that he had known about this abnormality of his mouth since childhood, and he stated that it had never caused any trouble. The patient was requested to inquire if any other members of his family had similar trouble. He was not able to find other relatives with similar involvement.

Microscopic examination of a biopsy (Fig. 2) of the oral lesion revealed considerable hyperplasia of the squamous epithelium with pronounced parakeratosis. In the parakeratotic layer and in the upper portion of the mal-

pighian layer, the cells were large and the cytoplasm contained granules of coarse hyaline material. The deeper portion of the malpighian layer was almost normal, except the cells were moderately edematous and an increased number of mitotic figures were present. Infiltrations of lymphocytes were present in the connective tissue. No indications were present suggesting that the lesion was precancerous.

Roentgenograms of the maxilla and mandible revealed generalized periodontal disease characterized by considerable lowering of the alveolar bone level and the presence of several alveolar abscesses. The mandibular and maxillary bone appeared similar to cortical bone in that the bone was unusually dense and lacked a normal cancellous pattern. The other flat bones appeared normal. The right and left lower third molars were found to be embedded.

Because of the periodontal disease and abscesses, the patient's teeth were extracted and dentures made. He was advised to stop smoking and to use an oral antiseptic.

The patient was seen again a year after his first admission. He had continued to take thyroid extract, and at this time no evidence of myxedema was present. The abnormal oral membranes, however, appeared unchanged except the denture-bearing areas now were a normal pink in color and of normal texture.

COMMENT—A man with pachyderma oralis, an atypical leukoplakia of the mucosa, was seen. The term, pachyderma oralis, for this condition seems preferable to a term which includes the word "nevus." The use of "nevus" may prove confusing as dermatologists employ it in referring to any congenital blemish.[5] In general usage "nevus" or "mole" has a more restricted meaning.

There appeared to be no distinguishing microscopic features that established with certainty the diagnosis from a biopsy. Consequently, it was necessary to correlate the clinical and microscopic data to arrive at the correct diagnosis.

5. Anderson, W. A. D., editor. Pathology. St. Louis, C. V. Mosby Co., 1948, p. 1239.

■ GREAT DEFICIT

Sherlock Holmes, in speaking of Francois de Villard, the French detective, said: "He possesses two out of the three qualities necessary for the ideal detective. He has the power of observation and that of deduction. He is wanting only in knowledge . . ." *Wilton Marion Krogman, "Sherlock Holmes as an Anthropologist," Scientific Monthly 80:155 March 1955.*

Alveolar ridge reconstruction with osseous autograft: *report of case*

■ *Roger G. Gerry, D.M.D., St. Albans, N. Y.*

During recent years there have been so many approaches to the problem of excessive alveoloclasia in the edentulous mandible reported that no further discussion of these technics is indicated here. The majority of procedures fall within two categories which imply either (1) increasing the depth of the labiobuccal sulcus, or (2) the use of an embedded, subperiosteal, metallic prosthesis. It is not the intent of the writer to evaluate the previously mentioned procedures, but to add a third, the restoration of the osseous height of the mandibular alveolar process with autogenous bone grafts.

For several years I have made occasional use of the maxillary alveolar process, removed during alveolectomy, for the correction of small defects in the mandible, such as the "knife-edge" ridge in the mandibular incisor region and, in one instance, a receding mental protuberance. These maxillary alveolar autografts have been introduced intraorally and placed subperiosteally. Although the graft itself sometimes was inadequate to correct the deformity, as in the instance of the mental protuberance, in all instances there was prompt repair of the overlying mucoperiosteum followed by vascularization and apparent incorporation of the graft, even after dental prostheses were inserted. On the same basis, when cancellous autografts from sites other than the maxilla, such as the iliac crest, have been used in the repair of traumatic injuries, or in marginal resection of ameloblastoma, the overlying mucoperiosteum has repaired promptly and vascularization of the graft has occurred early, although not as readily as when maxillary alveolar autografts were used. In these instances also, when dental prostheses were used, there was no tendency toward resorption of the graft.

These satisfactory results were not found in the use of frozen bone homografts for the correction of receding mental protuberances. Homografts were placed, subperiosteally, over the mental protuberance. Although the overlying mucoperiosteum healed readily, the graft itself was resorbed in a period of 6 to 12 months. This was contrary to the results of Converse.[1,2] This unsatisfactory result was not observed when ground cancellous homografts were used to fill bone cavities resulting from the enucleation of large cysts.

For the reasons already cited, when an edentulous patient had alveoloclasia which was so considerable that the procedures ordinarily used for the control of excessive alveolar resorption would not be applicable, it was decided that the most satisfactory result would be obtained by reconstruction of the alveolar crest with a cancellous autograft from the iliac crest.

REPORT OF CASE—A 40 year old white man appeared on February 3, 1953, with a history of having had all his teeth extracted 20 years previously. Since that time he had had increasing difficulty in using his mandibular complete denture, and for the past four or five years he had been unable to use it.

Examination at the time of admission indicated a complete absence of an alveolar ridge adequate to support a denture. Roentgenographic evaluation demonstrated that in the

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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1. Converse, J. M. Restoration of facial contour by bone grafts introduced through oral cavity. Plast. & Reconstruct. Surg. 6:295 Oct. 1950.

2. Converse, J. M., and Campbell, R. M. Experiences with bone bank in plastic surgery. Plast. & Reconstruct. Surg. 5:258 March 1950.

bicuspid regions the mandible was only 3 to 4 mm. thick (Fig. 1, left).

Prior to surgery, models of the potential denture-bearing regions of the maxilla and mandible were made, and the mandibular model was reconstructed in wax to provide an alveolar ridge which would be adequate to support a functioning mandibular denture. This wax pattern was reproduced in acrylic resin to be used as a model for the graft. An acrylic circumferential splint was then constructed to fit this graft pattern.

On February 25, under nasal endotracheal general anesthesia, a section of the left iliac crest was obtained in the usual manner. Care was exercised to take a block that was of sufficient size to allow the acrylic graft pattern to be included in its periphery. The iliac incision was then closed and dressed. The resected iliac block was decorticated with the motor saw and contoured to duplicate the acrylic graft model (Fig. 1, right). The site of the surgical procedure was then shifted to the mouth.

An incision was made through the mucous membrane of the mandibular buccolabial sulcus at the level of reflection of the sulcus with the lower lip so that the entire length of the incision was just large enough to admit the posterior extremities of the acrylic graft model. The mucous membrane was dissected until the periosteum at the superior border of the mandible was encountered. The periosteum was then incised horizontally for the same distance as the mucous membrane incision, and the exposure of the mandible continued, subperiosteally, to the right and left second molar regions.

The acrylic graft model then was placed through the incision, so that it rested on the superior surface of the mandible, with its heels extending subperiosteally to the right and left molar regions. The model was found to approximate bone at all parts on its inferior surface, and was withdrawn. The exposed portion of the mandible then was roughened with burs and rasps to provide a bleeding surface. During this procedure, it was observed that the inferior alveolar vessels were not covered with bone in the right and left bicuspid regions, and caution was exercised to avoid injuring them. The graft then was placed in position on the roughened

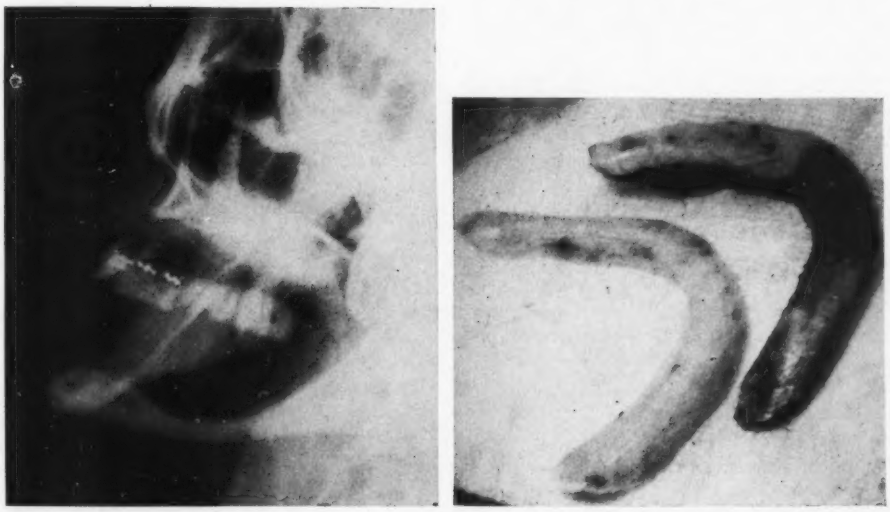

Fig. 1—Left: Right lateral oblique roentgenogram of patient at time of admission. Right: Iliac crest graft after it had been contoured to match prepared acrylic crest graft model. (Courtesy of Mr. Morton Russin)

Fig. 2—Left: Bone graft held in position with circumferentially wired acrylic splint. Right: Right lateral oblique roentgenogram of graft during period of fixation. Note circumferential wires. (Courtesy of Mr. Morton Russin)

superior mandibular recipient site and retained, temporarily, with two no. 000 chromic catgut sutures. The periosteal layer was closed as well as possible with no. 000 plain catgut interrupted sutures and the mucous membrane with no. 000 black silk interrupted sutures. The prepared acrylic splint then was placed over the mucous membrane and retained in position with three 0.018 inch stainless steel circumferential wires (Fig. 2), and a pressure dressing was placed over the lower lip and chin regions.

The intraoral incision was well healed by the sixth postoperative day, and the sutures were removed. On the fourteenth postoperative day, sutures were removed from the iliac incision. Roentgenograms taken five weeks postoperatively indicated vascularization of the bone graft with evidence of union to the mandible. The circumferential wires and splint were removed six weeks postoperatively (Fig. 2, right). At this time the graft was firmly bound to the mandible. The overlying mucoperiosteum was in good health except for a small defect, 2 by 3 mm., which had eroded through the anterior region and which exposed the graft underneath. In spite of this small defect, the patient was asymptomatic and was discharged to duty during the eighth postoperative week.

The patient was seen biweekly as an outpatient, and, except for the defect noted, he had no complaints. At the end of the third postoperative month, a small sequestrum was removed from the defect, and six months later, a small amount of necrotic bone was cut away, with rongeur forceps, through the defect to expose a bed of bleeding bone. After this procedure, the defect filled in, and a complete denture was placed at the end of the sixth postoperative month. By the time of insertion of the denture, the original defect had repaired. About two weeks after the patient started wearing his mandibular denture, however, another mucosal defect, exposing the graft, developed in the left bicuspid region. This defect also granulated over promptly when the patient refrained from wearing the denture. He began wearing the mandibular denture again at the end of the seventh postoperative month. The patient has been completely asymptomatic since that time, and has been wearing the same denture for 18 months with complete satisfaction. This denture is still firm and has not required rebasing. Except for the previously described,

small amount of bone loss under the anterior defect, the graft has shown no more disposition toward resorption than normal alveolar process (Fig. 3).

A similar operation making use of an autogenous iliac crest graft for alveolar reconstruction was performed by Stanley L. Lane in September 1953.[3] Dr. Lane placed, subperiosteally, two autogenous iliac crest grafts, 3 cm. in length, in the right and left mandibular bicuspid and molar regions. No additional fixation was used. A lower denture was inserted about seven months later. In a subsequent operation to adjust a muscle attachment, no line of demarcation between the mandible and the graft could be seen.

DISCUSSION—Ham[4] has pointed out that in full-thickness autogenous skin grafts in the pig, by the fifth postoperative day, the large vessels in the graft start to establish connection with the small vessels of the graft bed. By the tenth postoperative day the large vessels of the autogenous full-thickness skin graft are connected with the large vessels of the graft bed. In similar homografts there is no vascularization of the graft after ten days.

Ham has further pointed out that in autogenous bone grafts the bone cells themselves do not survive transplantation, but the cells of the periosteum and endosteum and the undifferentiated marrow cells survive transplantation, and, with similar cells of the graft bed, ultimately

3. Lane, S. L. Personal communication.

4. Ham, A. W. Some histophysiological problems peculiar to calcified tissues. J. Bone & Joint Surg. 34-A:701 July 1952.

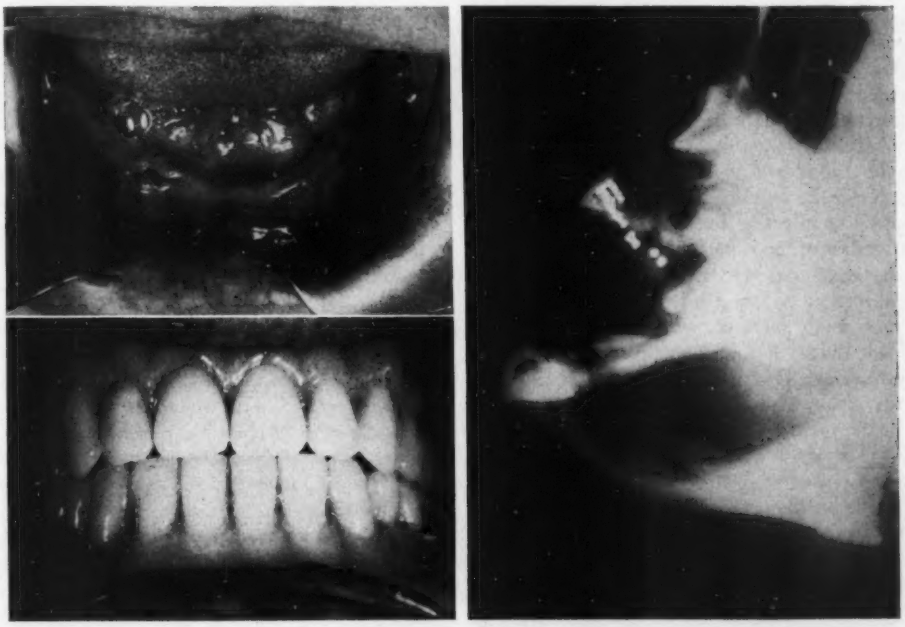

Fig. 3—Above left: Intraoral view showing preservation of well-developed alveolar ridge two years postoperatively. Below left: Intraoral view showing full dentures which were placed six months postoperatively and which have been worn for 18 months. Right: Right lateral oblique roentgenogram showing maintenance of alveolar crest height two years postoperatively. (Courtesy of Mr. Morton Russin)

form new bone to replace the original "dead" autograft. On this basis cancellous autografts repair more readily than cortical autografts, as the former contain a much greater proportion of covering and lining cells. Ham also has stated that even if none of the surface cells survive transplantation, as in the case of homografts, the cancellous fragments stimulate the osteogenic cells, osteoblasts and undifferentiated marrow cells of the host bone to grow into their midst and lay down new bone on their surfaces.

By inference, it may be assumed that in instances of bone homografts, survival of the periosteal, endosteal and undifferentiated marrow cells of the graft does not occur, and that replacement of the "dead" homograft with living bone must be accomplished entirely by these cells of the graft bed. On this premise it was felt that in using this procedure to replace resorbed mandibular alveolar process, the possibility of a successful "take" would be greatest if cancellous autogenous bone was used. This opinion was strengthened by the writer's lack of previous success in the use of frozen cancellous homografts.

There were several problems which had to be considered before a procedure of this sort could be considered. It was recognized that control of infection could be aided by the use of antibiotics, and that the patient was a much better than ordinary risk for a procedure of this sort as he was in excellent health and younger, 40 years of age, than the majority of edentulous patients with advanced alveoloclasia. Age alone, however, does not inhibit bone repair.[5] The poor covering of soft tissue was the most hazardous feature.

The only other alternative would have been to place the graft beneath the inferior mandibular border, which would have supplied more adequate covering tissues, but would have provided additional problems of retention, would have altered the patient's facies, and would have required a second procedure to deepen the buccolabial sulcus. The defect of the overlying mucosa which occurred was probably the result of prolonged (six weeks') retention of the circumferential splint. No secondary procedure to establish a sulcus was necessary, as the overlying mucoperiosteum became firmly bound to the graft, establishing an adequate sulcus.

It is recognized that this procedure is not indicated routinely for the treatment of advanced alveolar crest resorption in edentulous persons. The removal of an adequate iliac crest graft is a more formidable procedure than the restoration of mandibular contour, and hospitalization of two to three weeks is necessary. Since many patients who require correction of advanced mandibular alveoloclasia are elderly and in poor health, the wisdom of subjecting them to a purely elective procedure of this magnitude must be carefully weighed. The chance of survival of a cancellous autograft in an elderly patient is equivocal. The long period of delay between surgery and denture construction, possibly six months, constitutes another significant objection.

Of course, the successful outcome of this procedure for the first patient on whom it was attempted is not an indication that equally satisfactory results will always eventuate. This procedure is not suggested as an alternative to the conventional procedures, such as deepening of the buccolabial sulcus or use of subperiosteal metallic implants. In the younger patient who has many years to live with his problem of excessive alveoloclasia, however, the extra effort may be indicated.

SUMMARY—A case of excessive alveoloclasia of the edentulous mandible which was corrected with a cancellous autograft from the iliac crest is reported. This procedure was used successfully in a 40 year old patient. Roentgenograms taken two years postoperatively indicate that the height of the alveolar crest has been maintained.

The reconstruction of the edentulous mandible with excessive alveolar resorption by means of an orally introduced, cancellous autograft is not suggested for routine use. This procedure may be indicated, however, in the younger patient.

5. Markowitz, H. A. Personal communication.

The use of epinephrine-containing anesthetic solutions in oral surgery

CONTRARY TO POPULAR OPINION, the use of local anesthetic solutions containing epinephrine is not contraindicated for use in oral surgery patients with heart and circulatory disturbances when the epinephrine content does not exceed 1:50,000. Recent opinions[1] and accumulated clinical experience indicate that, if used with proper caution and adequate preoperative preparation, epinephrine-containing anesthetic solutions are actually safer than those not containing a vasoconstrictor. It has been pointed out by the New York Heart Association[2] that in general it is wise to limit the total dosage on any one occasion to no more than 10 cc. of 1:50,000 epinephrine-containing anesthetic solution, or no more than 0.2 mg. of epinephrine in any form.

Unfortunately, it is the opinion of many physicians and dentists that local anesthetic solutions containing epinephrine are unsafe for use in patients with heart disease. This is an unrealistic approach to a problem which is basically one of carrying out the necessary surgical procedure without disturbing the patient's cardiovascular status sufficiently to bring about deleterious changes. Actually, oral operations under local anesthesia without adequate vasoconstrictors are often associated with pain. Anxiety, apprehension and pain typically produce far more adrenalin by causing spontaneous natural secretion than does the injection of a moderate amount of a local anesthetic agent with 1:50,000 or 1:100,000 epinephrine. Adrenalin substitutes utilized in commercially available local anesthetic solutions theoretically carry more possibility of circulatory change than does the standard 1:50,000 epinephrine-containing local anesthetic solution.[2]

Patients with heart or circulatory disturbances are increased operative risks, and care should be taken to see that their physical abnormalities are recognized. To attain

1. Tainter, M. L.; Throndson, A. H., and Moose, S. M. Vasoconstrictors on the clinical effectiveness and toxicity of procaine anesthetic solutions. J.A.D.A. 25:1321 Aug. 1938.
2. Report of the Special Committee of the New York Heart Association, Inc., on the use of epinephrine in connection with procaine in dental procedures. J.A.D.A. 50:108 Jan. 1955.

this there should be the closest possible cooperation between the dentist and physician in the care of patients of this type. Treatment planning should be developed with special attention directed toward minimizing or preventing dangerous reactions or complications. Mental anxiety, pain or prolonged traumatic operations should be avoided. Adequate preoperative medication is therefore important. The barbiturates are usually the drugs of choice, although they may be used in combination with morphine or meperidine plus atropine or scopolamine when general anesthesia is used.

It should be recognized that general anesthesia is comparatively safe for such patients if they are adequately prepared and the anesthetic is properly administered. There should, of course, be a high intake of oxygen at all times to avoid any possibility of anoxia. It is especially important that there be proper teamwork between the anesthetist and the surgical team so that the operation can be performed with efficiency and dispatch. It is wise to avoid prolonged procedures under either local or general anesthesia, although in general it is possible to do more work safely under balanced general anesthesia or combined local and general anesthesia than under local anesthesia alone.

Basically the problem is best solved on an individual basis, careful consideration being given to the diagnosis, cooperation and treatment planning as well as to the patient's physical condition and attitude. The use of local anesthetic agents containing epinephrine assures the operator of adequate local anesthesia with a minimum amount of discomfort for the patient during the procedure. The addition of preoperative sedation and general anesthesia should be determined on an individual basis to insure a smoother and safer surgical procedure.—*Sterling V. Mead.*

The American Medical Association negotiations

IN ITS ANNUAL REPORT, the Special Committee on Problems in the Field of Oral Surgery incorporated the recent communication of the American Dental Association to the American Medical Association which points out that, despite the failure of the House of Delegates of the A.M.A. to rescind their unilaterally conceived definition of oral surgery,[1] members of the dental profession who practice oral surgery will continue to do so under the statutes of the various states, without regard for any pronouncements by the medical profession. It further states that the A.M.A. "definition," therefore, "can only be a source of annoyance to dentists in their relations to hospitals and may depreciate the friendly and cooperative relations which now exist between dentist and physician as members of a local community and health team."

The legality of dental practice in all its phases is well established in each state, and although there are minor variations in the definition of the field of dentistry, the dental practice acts in each instance are sufficiently broad to encompass and give legal authority to what has been officially defined by the American Dental Association as oral surgery.[2]

It is to be expected, therefore, that dentists practicing oral surgery will continue in their chosen field. It is sincerely hoped that through an improved insight, our medical colleagues will see fit to recognize the legal, moral and ethical problems involved and develop a spirit of cooperation that has not as yet been officially apparent.

1. Report of reference committee on medical education and hospitals. Proceedings of the House of Delegates, A.M.A., June 1-5, 1953. J.A.M.A. 152:731 June 20, 1953.
2. Transactions of the American Dental Association, 1953, p. 249.

■ Extrusion of the second molar by impacted third molars will create an occlusal imbalance because of the traumatic relation of the second molars. Such chronic distortion of the masticatory neuromuscular balance will contribute significantly toward temporomandibular joint disturbances.

■ When surgical procedures on impacted cuspids, tori, and oroantral fistula require elevation of mucoperiosteal flaps from the palate, such flaps are best supported by splints during the period of early healing. Palatal appliances of this type may be constructed preoperatively, may be of acrylic materials, and can be modified at the time of surgery. They should meet the requirements of sufficient support and stability without compression of tissue or restriction of blood supply.

■ Differences of opinion exist regarding the period of fixation for fractures of the mandibular condyle that are treated by closed reduction. Several authors have stated that these fractures should be mobilized early in order to produce a "flail joint" at the fracture site. They suggest a period of two to three weeks of immobilization. In many instances in which there are associated fractures in other parts of the mandible requiring six weeks of fixation, the condylar fractures do well. There are various types of condylar fractures and indications for closed reduction, open reduction, or even condylectomy. If the closed reduction method is elected, six weeks of fixation will achieve a more satisfactory healing at the fracture site. Therefore, a shorter period of immobilization of the jaws in this type of mandibular fracture is not recommended.

■ In the contouring of alveolar ridges for prosthetic appliances, attention is usually drawn to areas of irregularity and undercuts on the buccal and labial surfaces. The areas of irregularity on the superior aspect of the lingual alveolar ridge frequently are neglected. Many oral surgeons hesitate to reflect the mucoperiosteum in this region because of the dangers of infection. Although precautions should be taken to avoid extensive reflection of tissue from the lingual aspect of the alveolar ridge, the crest region should be exposed so that irregularities may be removed which later would cause prosthetic difficulty. This is particularly important in the molar region and in prominent alveolar regions around residual teeth.

■ Attention is directed constantly to a need for rapid and extensive topical anesthesia of oral mucous membranes; for example, for the control of painful lesions or gag reflexes, for intraoral roentgenography and for impression technics. Various agents have been developed for this purpose. Recently a preparation of lidocaine in carboxy methyl cellulose (Xylocaine viscous) has been used in clinical trial. These agents have inherent limitations but will continue to be greeted with great interest.

Readers are invited to send their clinical observations to the editor, Fred A. Henny, Henry Ford Hospital, Detroit.

■ Removal of Unerupted Third Molars

Q.—What is your opinion about removal of partially developed and unerupted maxillary third molars during the preparation of the mouth of a young person for dentures?

A.—Since the role of the alveolar process is functional, the tuberosity region of the maxilla develops in support of the third molar. It, therefore, appears logical to retain these third molars until they descend to the alveolar crest. The patient should be informed of the reasons for retention of these teeth, and periodic roentgenograms should be taken so that the status of the molars is known. When these teeth appear at the surface of the alveolar ridge, they may be removed with conservation of alveolar process. Close observation and modification of the denture are required in such a program, but through it, an important foundation for the prosthesis is preserved.

■ Sensitivity to Antibiotics

Q.—What are your recommendations concerning the management of sensitivity reactions to antibiotics? Recently a patient was encountered who had no previous history of reaction to penicillin, yet 30 minutes after the administration of 300,000 units of procaine penicillin, he returned to the office with shortness of breath, violent itching of the skin, and in a general condition approaching shock. Although medical aid was available immediately in this situation, I am interested in measures which might be taken in the future if such an emergency arose.

A.—Reactions to penicillin have wide variation in type and degree of severity. Although a negative history is significant, it is not infallible. An acute reaction, such as described, would indicate administration of epinephrine 1:1,000 subcutaneously (0.3 cc. to 0.5 cc.) in repeated dosage every 30 minutes as necessary for the relief of symptoms. Antihistamines such as diphenylhydramine hydrochloride (Benadryl), 100 mg., may be given by mouth. A physician should see the patient and follow his condition. Steroid therapy (cortisone) is also available and has been found helpful in the management of severe reactions.

■ Removal of Supernumerary Tooth

Q.—Roentgenograms taken of a five year old child revealed an inverted midline supernumerary tooth that was causing the deflection and rotation of the developing permanent central incisors. The deciduous central incisors are in normal occlusion. When would you recommend surgical intervention to remove the supernumerary tooth?

A.—This condition should be corrected surgically as soon as possible. The deciduous central incisors may be removed at the time of the intervention in order to afford greater access. Care must be taken in the removal of the supernumerary tooth so that trauma to the developing permanent central incisors is avoided.

This section devoted to queries and comments from readers on topics of current interest to oral surgeons and general dental practitioners is edited by James R. Hayward, University Hospital, Ann Arbor, to whom readers are invited to send their communications. The answers, prepared by competent consultants, do not necessarily represent the opinions of any official scientific organization. Your participation in this section is invited.

The Editor

■ Gustatory Hyperhidrosis

Q.—A patient who had had surgery performed in the region of the temporomandibular joint two years ago now complains of perspiration from the skin area in front of the ear. This localized sweating appears at mealtime. Do you have any explanation for the phenomenon?

A.—This condition has been termed gustatory hyperhidrosis, and is a sequela to surgical intervention of this region. The phenomenon is thought to be due to anomalous autonomic pathways to the sweat glands which thereafter are affected by salivary reflexes.

■ Secondary Infection After Removal of Third Molars

Q.—Recently an 18 year old healthy girl came because of pain and swelling in the region in which a lower third molar had been removed six months ago. Healing after the extraction had been reported as uneventful. Roentgenograms show little repair of bone but no other abnormalities. Examination revealed a small sinus tract from which exudate could be expressed and through which a small probe could be passed into the cavity. This chronic condition has remained fairly dormant, and the nature of the lesion is not fully understood. How may these changes be interpreted?

A.—In the removal of unerupted third molars, a primary closure of the flap occasionally will be followed by breakdown and production of dead space. This creates a potential region for secondary infection through contamination with saliva, food particles and debris. If there are epithelial remnants in the vicinity they may be stimulated to proliferate in the inflammatory region and produce a cystic lining in the cavity. These conditions necessitate surgical intervention to open the region for thorough inspection and for the removal of exudates, granulation tissue or epithelial linings. The reparative process should begin at the depth of the cavity, and the surface opening should be retained until the reparative process is complete.

■ ADVANCES IN EXPERIMENTAL CARIES RESEARCH. Edited by R. F. Sognnaes. 236 pages. Washington, D. C., American Association for the Advancement of Science, 1955.

This book is based on a symposium presented at the 120th annual meeting of the American Association for the Advancement of Science, Subsection on Dentistry. The 11 chapters have been contributed by 20 investigators representing not only dentistry but the various basic sciences.

The first chapter serves as an adequate introduction to the problems confronted by a researcher in dental caries. The selection of test animals, the nature of experimentally produced lesions, and the evaluation of these lesions are described in detail. The material for this chapter was drawn from the leading caries research articles of the last 35 years.

The second chapter deals with the location of experimental caries on different tooth surfaces of the rat. How the caries are found and evaluated is discussed. In addition, a description is included of the dietary factors necessary for the production of fissure and smooth surface caries.

Each of the following factors that influence dental caries, genetic, developmental, dietary, salivary and endocrine, is treated completely and individually in the next five chapters.

The chapter dealing with intraoral effects on experimental hamster caries discusses the following factors: (1) tooth morphology, (2) types of carbohydrates ingested, (3) eruptive age factor, (4) salivary function, (5) influence of toothbrushing and therapeutic dentifrices.

The discussion in chapter 9 regarding the oral environmental factors describes the use of germ-free animals in dental caries research. The report is concerned with two definitive caries-producing factors, microorganisms and food substrate in the oral cavity. The series of experiments described showed that no dental caries occurred in rats reared entirely free of microorganisms or which were fed by a stomach tube that bypassed the oral cavity completely, indicating that oral food debris and bacteria are essential for caries to occur in the rat.

The influence of antibiotics and various other agents on experimental caries composes the next two chapters. The book is completed by a general summary by the editor in which all the material presented in the book is correlated and listed in nine brief categories.

This book is an excellent comprehensive review of recent caries research in animals, bringing together under one cover all of the most fruitful experimental caries research in the last 35 years. The American Association for the Advancement of Science is to be congratulated for sponsoring such a worthwhile and badly needed project.—*William F. Via, Jr.*

■ THE MANAGEMENT OF ORAL DISEASE. By Joseph L. Bernier. 805 pages with 1,001 illustrations and five colored plates. Index. $15. St. Louis, C. V. Mosby Co., 1955.

This generously illustrated, well written text by an illustrious oral pathologist is a welcome addition to dental literature. In systematic fashion, the author covers the field of oral disease, including etiology, diagnosis, pathology and to a lesser degree, treatment. In addition to a discussion on tumors, the book includes a careful discussion of many other oral diseases such as superficial infections of the oral mucosa, oral manifestations of systemic or generalized diseases and specific inflammatory lesions of the oral cavity.

Considerable emphasis has been placed on diagnosis as a keystone in the management of oral disease. In this regard biopsy is emphasized as of great importance. The indications for biopsy, the technic of obtaining the specimen, fixation and subsequent care of the tissue

specimen are covered with clarity and are adequately illustrated. Microscopic evaluation of tissue specimens is included throughout the entire text under the discussion of individual diseases, and here again illustrations are generously used to record the microscopic findings that are typical of the lesion in question.

Some 130 pages are devoted to the discussion of benign and malignant tumors of the oral region. The individual lesions are covered in detail; emphasis is placed on the characteristic clinical and histopathological features. Only the broad principles of treatment are included in this section, but the author furnishes a complete bibliography for easy reference.

The Management of Oral Disease is a worthy addition to any dental library and can be recommended with enthusiasm.—*Fred A. Henny.*

■ FORTSCHRITTE DER KIEFER- UND GESICHTS-CHIRURGIE: EIN JAHRBUCH, BAND I. (ADVANCES IN MAXILLO-FACIAL SURGERY: A YEARBOOK, VOLUME I). Edited by K. Schuchardt and W. Wassmund. 259 pages with 372 illustrations. 48 DM. Stuttgart, Georg Thieme, 1955.

This volume contains a collection of lectures on oral surgery and orthodontics by 55 distinguished German and European authorities. These scientists have combined in their contributions knowledge of both the basic dental sciences and clinical research. The lectures display a panorama of objectives and achievements; all the papers are immensely useful, practical and informative. The degree of this book's value will of course depend on the use that the reader makes of the material offered.

Unfortunately, neither bibliography nor index is present; both could make this book more valuable. The illustrations are well chosen and clear; the binding is adequate and the type excellent. The material presented will be of value not only to the limited group for whom it was written but to all who are interested in the advances made by recent methods of research.—*Paul H. Glucksman.*

■ RÖNTGENDIAGNOSTIK DES SCHÄDELS (ROENTGENOGRAPHIC DIAGNOSIS OF THE SKULL). By Willy Loepp and Reinhold Lorenz. 579 pages with 613 illustrations. Index. 97 DM. Stuttgart, Georg Thieme, 1954.

The introductory chapters on normal skulls and those on skulls deformed by disturbances of development and growth are followed by material on inherited disorders (dysostoses), endocrine disturbances, generalized diseases (Paget, Albright), lipoid storage diseases (Niemann-Pick, Hand-Chester-Schüller-Christian, and others), avitaminoses and parasitic diseases and inflammatory diseases, which may affect the roentgenographic appearance of the skull. Special chapters are devoted to benign and malignant tumors. The more extensive chapters are those on skull fractures (including fractures of jaws and teeth), the basis cranii, sella turcica, temporal bone, sinuses, orbit and jaws and teeth. A final section is devoted to roentgenographic technic.

Material in the chapter on jaws and teeth includes a brief account of development and general roentgenology, inflammatory diseases of the teeth, apicoectomy, granulomatous swellings, epithelial cysts, inflammatory diseases of the jaws, nonpyogenic necrosis of the alveolar processes, benign and malignant tumors, local amyloid tumors, acromegaly, rickets, familial fibrous dysplasia of the jaws and systemic disease (Albers-Schönberg, von Recklinghausen, and others).

This book illustrates and describes a wide range of injuries and diseases of the skull and should be highly valuable to the diagnostic roentgenologist. Well over half the material presented should be of direct interest to those persons who are engaged in maxillofacial and oral surgery.

The roentgenograms are excellent and well selected. They are reproduced by a fine-screen process on good quality smooth paper to give clarity and minute detail.

The book is well indexed according to author and subject. A valuable feature is the bibliography which gives a generous sampling of the pertinent recent literature and a few of the classical works. Some 700 references are

given, of which nearly 90 per cent are to German articles; the remainder are chiefly in English with only a few titles in French and Italian.

The crisp, concise style of the author and the similarity of many of the German medical and anatomical terms to their English equivalents should permit easy comprehension by those with only a fair reading knowledge of German.

■ THE PHARMACOPEIA OF THE UNITED STATES OF AMERICA. Prepared by the Committee of Revision and issued by authority of the 1950 U. S. Pharmacopeial Convention. Fifteenth revision. 1,178 pages. Index. $10. Easton, Pa., Mack Publishing Co., 1955.

This work, which is generally called the *USP*, is revised at five year intervals. In the period between revisions, supplements are sent to those purchasers of the book who request them. The *USP* has official standing under the terms of the federal Food, Drug and Cosmetic Act. Drugs listed in it are referred to as "official." The standards of the fifteenth revision of the *USP* will probably become effective late in 1955.

The *USP* lists drugs and pharmaceutical aids "the utility of which is most fully established and best understood." Mere extensive use is not a sufficient basis for the listing of a drug in the *USP*.

The major portion of the book consists of monographs which describe drugs, specify tests for them and mention at least one category for their use. If a drug is for internal use a usual dose is stated; and, in this revision for the first time, a range of dosage is given. The statement with regard to category of use is also a new feature.

About one third of the book is devoted to test procedures, processes, apparatus, reagents, atomic and molecular weights, conversion tables for temperature, weights and measures, and a general index.

Editorially, this revision is much improved. In accordance with current trends, dosages are given in the metric system exclusively. Ml. has replaced cc., very little Latin is used and the chemical structural formulas are streamlined and easier to read.

This revision of the *USP* should be in every dental school library and in the office libraries of those who teach or do research in pharmacology and therapeutics.—*Donald A. Wallace.*

■ Cysts and Carcinoma of the Jaws. Gunnar Martensson, L.D.S., M.D. Oral Surg., Oral Med. & Oral Path. 8:673 July 1955.

One of the principal means of establishing the diagnosis of carcinoma arising from the mucous membrane of the paranasal sinuses is by roentgenologic examination. If malignancy is present, it usually will be possible to demonstrate destruction of the sinus walls. Such destruction, however, cannot be demonstrated at an early stage. Further, destruction of the maxillary walls is not necessarily proof of a malignant tumor. Odontogenic cysts may be attended by bone destruction typical of carcinoma.

Of exceptional importance is the fact that the epithelial lining of a cyst may undergo malignant changes. Histologic examination of cystic linings removed from jaws, therefore, should never be omitted.—*H. J. Bloom.*

■ Six Years of Practical Experience in Maxillo-Facial Surgery in Indo-China. G. Bernard. Rev. de stomatol. 55:346 June 1954.

Vaccinotherapy was used successfully in instances of osteitis which were treated in connection with reparative work done for maxillofacial injuries in Indo-China. Propidon was used in subcutaneous infections in doses which increased from 2 cc. to 6 cc. in a period of five days.

In some fractures where bone loss and pseudarthrosis occurred, there was no appreciable functional disability after proper treatment. Because function was fairly good, the necessity of grafting is questioned, particularly in instances of damage and pseudarthrosis of the ascending ramus.

Pseudarthroses are most likely to occur at the symphysial region because of the distance from the active osteogenic center and because of the amount of jaw motion in this region.

Rules are given for the time of grafting, the choice of a graft and the grafting technic. In severe bone loss, a rib graft placed into the defect was fastened with screws. Homografting gave satisfactory results, although a longer time was required for a complete reorganization of the graft (up to 20 months from the time of the roentgenographic observations). When autogenous grafting was used, only 8 to 10 months were required. The report is based on experience with 721 war injuries treated over a six year period.—*Jacques Levignac.*

■ Management of the Cleft of the Alveolar Arch, Either Unilateral or Bilateral. Wm. L. Shearer, M.D. Plast. & Reconstruct. Surg. 14:281 Oct. 1954.

The embryohistological development of the jaws is reviewed. Since a cleft palate is a failure in development, it should be the surgeon's aim to create as nearly as possible a normal arch. Most intraoral plastic surgery is badly handled. The theory of correcting a cleft lip and leaving the cleft of the alveolar arch unattended, relying on the pull of the fibers of the orbicularis muscles to bring the parts into position, is to be criticized. Correction of the alveolar arch in early infancy does not retard the development of the jaw. In addition, the vast majority of people have to wear dentures later in life, and it is impossible for them to do so if the alveolar arch and palate are not made fairly normal. To do this successfully, one must know how to do an alveolectomy properly, as alveolectomy is the first stage of the Brophy operation, the procedure of choice in correcting an alveolar arch cleft.—*Myron Kaufman.*

Announcements

■ Harry Seldin Succeeds Stanley Rice as President of American Society of Oral Surgeons

Harry M. Seldin of New York was installed as president of the American Society of Oral Surgeons at the Society's 36th annual meeting in Los Angeles October 11-14. He succeeds Stanley Rice of Beverly Hills, Calif. Other officers are G. T. Gregory of Indianapolis, president-elect; W. T. Foster of San Antonio, Texas, vice-president; F. B. Hower of Louisville, Ky., secretary-treasurer and Ruth F. Whalen of Richmond, Va., executive secretary. The next annual meeting will be September 25-28 in New York.

■ Kansas City School Offers Graduate Training in Oral Surgery

The University of Kansas City School of Dentistry in Kansas City, Mo., is now accepting applications for a three year course in oral surgery sponsored by the school in conjunction with Kansas City General Hospital Number One. The program is designed to meet the requirements of the American Board of Oral Surgery. Graduate courses begin July 1. Applications should be on file not later than March 1.

The school also announces that two rotating internships are offered in conjunction with the Veterans Administration Hospital of Kansas City and the Veterans Administration Hospital of Wadsworth, Kan. Information on the internships may be obtained from James P. Darnell, chief of the dental section, Veterans Administration Hospital, Kansas City, Mo., or from Dayton D. Krajicek, chief of the dental section, Veterans Administration Hospital, Wadsworth, Kan.

■ Schools, Hospitals Announce Residencies, Internships

Oral surgery internships and residencies have been announced recently by four schools and two hospitals. Internships are available at the College of Dentistry, University of California Medical Center, in San Francisco, and at the Research and Educational Hospitals of the University of Illinois in Chicago. Internships and residencies are announced for the University of Louisville School of Dentistry in Louisville, Ky., where the program is sponsored in conjunction with the Louisville General Hospital; for the University of Alabama School of Dentistry and the University Hospital in Birmingham; for the Mount Sinai Hospital in New York, and for Bronx Municipal Hospital Center, Albert Einstein School of Medicine, the Bronx, N. Y.

■ Dental Abstract Journal Now Has 6,600 Subscribers

More than 6,600 subscriptions for DENTAL ABSTRACTS, the Association's new monthly journal, had been received by November 10, according to John J. Hollister, business manager. The first issue will appear January 10, 1956. Several hundred subscriptions were obtained at the recent annual session of the Association in San Francisco.

Domestic subscriptions ($6) and foreign subscriptions ($7) may be obtained from the Subscription Department, American Dental Association, 222 E. Superior St., Chicago.

■ Mexican Society to Meet in February

The Sociedad Dental de Durango, Mexico, will meet February 23-25 in Durango. It will be the group's sixth annual meeting. Federico Romo G. is president.

■ International Associate Editor Appointed for Journal of Oral Surgery

Claudio Funcia Cornell of Havana, Cuba, has been appointed international associate editor of the JOURNAL OF ORAL SURGERY, according to a recent announcement by Fred A. Henny, editor. "Dr. Cornell's appointment will broaden the sphere of usefulness of the JOURNAL OF ORAL SURGERY," Dr. Henny said. "We expect an increase in the number of contributions from Pan-American oral surgeons."

Editorial communications

■ ORIGINAL COMMUNICATIONS—This journal invites concise original contributions in the broad field of clinical and experimental surgery of the mouth and associated structures, including roentgenology, diagnosis, anesthesia and oral surgical pathology. Articles are accepted for publication with the understanding that they are contributed solely to the JOURNAL OF ORAL SURGERY. All manuscripts are subject to editorial modification. Neither the editors nor the publishers accept responsibility for the views and statements of authors expressed in their communications.

■ MANUSCRIPTS—Manuscripts submitted for publication should be sent to Fred A. Henny, Editor, Henry Ford Hospital, Detroit, Michigan.

Manuscripts should be typewritten on one side of the paper only with double spacing and liberal margins. The author's name and abbreviated title of the article should appear at the top of each manuscript page. The original should be sent to the editor and a carbon copy retained by the author. Manuscripts will not be returned if accepted for publication.

References should be placed at the end of the article and should conform to the style of the Quarterly Cumulative Index Medicus; viz., name of author, title of article and name of periodical with volume, pages, month and year. They should be numbered and should appear in the same order as that of the superior figures inserted in the appropriate positions in the text.

■ ILLUSTRATIONS—Illustrations accompanying manuscripts should be unmounted and numbered. The author's name should appear on the margin or back.

Authors should insert figure numbers at appropriate places in the text. The original drawings, or glossy print photographs of them, should accompany the manuscript. Legends for illustrations are to be typewritten in a separate list with numbers corresponding to those on the photographs and drawings.

A reasonable number of halftone illustrations will be reproduced free of cost to the author, but special arrangements must be made with the editors for color plates, elaborate tables or extra illustrations. Copy for zinc cuts (such as pen drawings and charts) should be drawn and lettered in India ink or with black typewriter ribbon (carbon paper placed with carbon against back of sheet for bolder type). Ordinary blue or colors will not reproduce. Only good photographic prints or drawings should be supplied for halftone work.

■ CASE REPORTS—Case reports will constitute an important department of the journal and the editors welcome case reports that are of unusual clinical value or that present exceptional conditions of interest.

■ EXCHANGES—Letters, exchanges, reprints and all other communications relating to the JOURNAL OF ORAL SURGERY should be sent to the American Dental Association, 222 East Superior Street, Chicago 11.

Announcing

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April 2-3, 1956

(Applications should be received by March 1, 1956)

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